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METRIC CONVERSION COSTS FOR SELECTED INDUSTRIAL ARTS PROGRAMMES IN THE PROVINCE OF ALBERTA

by

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A THESIS

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The undersigned certify that they have read and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled, "Metric Conversion Costs for Selected Industrial Arts Programmes in the Province of Alberta," submitted by Robin Christopher John Lawrence Harrison, in partial fulfilment of the requirements for the degree of Master of Education in Industrial Arts.

Date April 10, 1975

ABSTRACT

The primary objective of this research study was to determine the costs that would be incurred by the various school boards of the Province of Alberta, offering programmes in industrial arts as they convert from the imperial system of measurement to that of SI units of measurement.

A research questionnaire, containing a list of hand tools and machine tools, found in industrial arts laboratories, and subject to metric conversion, was constructed and used in a pilot study. Later, this instrument was used in the major study.

From a total population of 311 schools that offered an industrial arts programme of study, a random sample was taken. This sample was stratified according to their organizational pattern and according to urban/rural disposition. This procedure yielded 18 urban schools and 7 rural schools to participate in the study.

Of the 25 research instruments mailed to the participating schools, 22 were completed and returned. This represented a total response of 88 percent from those schools involved in the research.

Data calculated from the research instrument were placed in tabular form for analysis. From these data observations for the study were made, conclusions were drawn, and recommendations presented.

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CHAPTER I

INTRODUCTION

The Government of Canada in January 1970 issued a White Paper, thereby setting out the broad principles of its policy with regard to the SI (Systeme International d'Unites) units of measurement as follows:

(1) The eventual adoption in Canadian usage of a single coherent measurement system based on metric units should be acknowledged as inevitable and in the national interest.

(ii) This single system should come to be used for all measurement purposes required under legislation, and generally be accepted for all measurement purposes.

(iii) Planning and preparation in the public and private sectors should be encouraged in such a manner as to achieve the maximum benefits at minimum cost to the public, to industry, and to government at all levels (White Paper, 1970, p. 8).

In 1971 the Government established the preparatory Committee for Metric Conversion, chaired by Mr. S. M. Gossage. The Commission had as its basic premise the investigation of the implications of conversion for the SI units of measurement. At that time, the Commission stated that conversion should therefore be planned and co-ordinated, but not legislated.

Changes were therefore made, but unfortunately it was regrettable to note that there were many teachers and educationists who were unaware of the actual state of affairs.

Publicity, often nondescript and out of context, thereby prevented the true importance to be acclaimed. Gradually this was

improved upon, in that it became national policy to adopt the SI units of measurement fully.

The Chairman of the Metric Commission supported this in his address to the Alberta Invitational Conference on Metric Conversion (Edmonton, October 17 and 18, 1973) by saying:

> The first step of the Commission was to approach all the more significant trade and industry associations asking them to study the impact on their industries of metric conversion and to request a timetable most suitable to their particular conditions. It (the Commission) has also written to all provincial governments to inform them of the Commission's approach and to call attention to a number of areas which would appear to be primarily a provincial responsibility (minutes electronically recorded).

In conjunction with this, some form of planning and interplanning was needed in education as conversion to SI units of measurement would certainly entail additional costs. Conversion would also affect curricula change. Metric learning materials would have to be prepared by suppliers, or educators. At the same time it became desirable that textbooks reflected the conversion from imperial measurement to that of SI units of measurement. Equipment in industrial arts laboratories also needed to be modified and certain hand tools purchased.

This conversion had implications for changeover costs which in turn affected the budgets of school boards throughout the province. What these costs were had not been determined through systematic research.

Statement of the Problem

The purpose of this research study was to determine the costs that were to be incurred, by the various school boards in the Province

of Alberta, in the junior high school and senior high school industrial arts programmes of studies supported by the Provincial Department of Education, as they converted from the imperial system of measurement to the Systeme International d'Unites (SI) units of measurement.

Objectives of the Study

The study had the following supporting objectives:

1. To determine replacement costs of tools used to work materials that were normally found in industrial arts, that conversion to the SI units of measurement influenced.
2. To determine modification costs to machines used to work materials that were normally found in industrial arts, that conversion to the SI units of measurement influenced.
3. To determine replacement costs of tools used within the technology areas normally found in industrial arts, that conversion to the SI units of measurement influenced.
4. To determine modification costs to machines used within the technology areas normally found in industrial arts, that conversion to the SI units of measurement influenced.

Need for the Study

At the present time 90 percent of the world has gone metric or is in the process of converting to the SI units of measurement. Because Canada is one of the industrial countries that has not made this conversion, it must eventually change to SI units of measurement because of her economic position as an exporter of raw materials or finished goods to the world market.

To support this, Groner and Boehm (1973) have stated:

> The cost of metric conversion, and the extent of eventual benefits are naturally matters of primary concern. Certainly expert planning and coordination can do a great deal to reduce confliction, conflicts, and the traditional expense of carrying dual inventories (p. 31).

For education the implications of the change were clear. Education had to prepare pupils for contact with the metric system, in particular the SI units of measurement. By accomplishing this, pupils when they go on to work in science, commerce and industry would be able to adapt to the changes in daily life which would follow from metric conversion.

These changes affected not only the teaching of science and mathematics, but also subjects such as social studies, industrial arts and industrial education.

Within the realm of education during the 1973-74 academic year, no formal research studies had been conducted in Canada that were directed at a cost analysis of conversion to SI units of measurement.

A United States metric study estimated that it would cost the United States one billion dollars for the cost of changing textbooks and capital equipment over a period of three to five years. Mr. P. Boire of the Metric Commission of Canada has suggested that no one really knew with any precision what the costs of conversion would be.

That costs would be incurred was realized, but the actual extent of these costs posed a question that could best be answered by the completion of a cost analysis study.

Delimitations and Limitations of the Study

This study had the following delimitations and limitations:

1. It was delimited to the industrial arts programme of study taught in junior and senior high schools within the Province of Alberta, selected to participate in this study.
2. It was delimited to the capital equipment identified in the junior and senior high schools selected to participate in the investigation.
3. It was delimited to the time frame during which the study was conducted, the 1973-74 academic school year.
4. It was limited to the accuracy of responses received from the school administrators and industrial arts teachers of the schools selected to participate in the research.
5. It was limited to a cost analysis that would be determined by current (1974-75) prices that were available to the researcher during the time frame of the study.

Operational Definitions

The following operational definitions of terms which specifically applied within the framework of the study are set out below:

Capital Equipment

Silvius and Bohn (1961) suggest that this "... would include the tools and machines that can be used again and again over a period of time (p. 42)."

Cost Analysis

Fowlkes and Hansen (1952) gave the most complete definition for

the term cost analysis. This definition was considered appropriate for this study. According to these authors, cost analysis is:

> ... the process of studying the total costs of public education for a given community, state or area for a given year; trends in total school costs; the cost of specific services or subjects, e.g. transportation or English; the cost of education by grades or levels, e.g. elementary school costs, secondary school costs; cost of now--attendance; costs and taxpaying ability; cost and size of school; reasons for increased costs and need for decrease in costs (p. 23).

Imperial System of Measurement

The predominant system of weights and measures used in Canada composed of common basic units as inch, foot, yard, mile, pint, quart, bushel, ounce, pound, degree fahrenheit, the ampere, and the second.

Industrial Arts

For the purpose of this study the definition of industrial arts as given by Feirer and Lindbeck (1964, p. 15) will be used:

> ... industrial arts is the broad study of the tools, materials, equipment, processes, products and occupations in industry pursued for general educational purposes in shops, and laboratories of schools.

Junior High School

In this study junior high school refers to schools which enrolled only grades 7, 8 and 9, and offer a programme of studies in industrial arts as authorized by the Provincial Department of Education.

Materials

Those areas that lent themselves to the product methods, incorporating tools; materials and processes, namely woods, metals, plastics and ceramics (paraphrased from Curriculum Guide, 1969).

Multiple Activity Laboratory

An adequate definition of the term multiple activity laboratory was found in the Junior High School Curriculum Guide in Industrial Arts, 1969, for the Province of Alberta. According to this publication a 'multiple activity laboratory' is defined as "a laboratory where three or more activities are in progress at the same time" (p. 3).

Rural Community

A rural community for the purposes of this study refers to a community with a population of less than 5,000 persons who reside in that community. One exception was that of Peace River, which, though classified as a rural community, had a population of 5,039. This data required to substantiate the definition was obtained from, Quick Canadian Facts, 28th Annual Edition, The Canadian Pocket Encyclopedia, 1972 (p. 70).

Senior High School

For this study senior high school refers to schools which enrolled only grade 10 and above, and offer a programme of studies in industrial arts as authorized by the Provincial Department of Education.

Systeme International d'Unites

The definition given by Leggett (1971) in Standards in Canada for the term Systeme International d'Unites, SI units of measurement, was accepted for this study. Leggett presents the following definition for SI:

> The Systeme International consists of six basic units and the coherent units derived from them. The basic units are for length (metres), mass (kilogram), time (second), electric current (ampere), absolute temperature (degree Kelvin), and luminous intensity (candela) (p. 51).

Technologies

Those areas that lent themselves to the experimental approach, allowing for interrelationships and applications to be established, in the many processes encountered in the materials area. Such technologies included: electricity, electronics, computers, power mechanics, graphic arts and graphic communications (paraphrased from Curriculum Guide, 1969).

Urban Community

An urban community for the purposes of this study refers to a community with a population of greater than 5,000 persons who reside in that community. Data substantiating this definition were obtained from, Quick Canadian Facts, 28th Annual Edition, The Canadian Pocket Encyclopedia, 1972 (p. 70).

Population and Sample

For this study the population included all junior and senior high schools in the Province of Alberta, which offered a programme of studies in industrial arts.

From this population a stratified random sample of junior high schools and senior high schools from both urban and rural settings was drawn. To identify the schools that were included in the sample, a table of random numbers was used, following the procedure recommended by Ferguson (1971, p. 122).

The proportion of schools drawn was approximately a ratio of two urban schools to one rural school, and two junior high schools to one senior high school.

Methodology

The following methodology was used to collect data for analysis in bringing this study to its conclusion.

To identify senior high school and junior high schools in the province that offered a programme of studies in industrial arts, the researcher corresponded with the Consultant in Industrial Arts for the Province of Alberta asking that this information be made available. The purpose of this correspondence was to identify senior high schools and junior high schools in urban and rural settings in the province that offered course work in industrial arts.

From this list of schools received a stratified random sample was drawn using the procedure for drawing such a sample recommended by Ferguson. This procedure was repeated until two urban schools had been selected for each rural school. An identical procedure was repeated until a ratio of two junior high schools to one senior high school was identified. The schools so identified became the participating schools for this study.

The Consultant in Industrial Arts for the province was asked to furnish the researcher with the most recent equipment lists for industrial arts. The equipment lists served as a basis for identifying the basic items of capital equipment used in the various programmes of studies that made up industrial arts. The equipment lists for each programme of studies in industrial arts were used as a baseline by the researcher in designing the research instrument administrators in the schools identified in the randomization procedure.

Concurrently, a letter was forwarded to the superintendents of

those schools selected for the study. The purpose of this correspondence was to solicit the cooperation of the administrator to permit the industrial arts teachers of the school to participate in the study.

A library search and review was made of the literature that was primarily concerned with instrument design. The purpose of this search was to assist the researcher in the design of questions used as part of the research instrument which included a list of equipment normally found in industrial arts laboratories.

The equipment list included a list of tools and capital equipment normally found in junior and senior high school laboratories that were recommended by the Department of Education for the Province of Alberta.

The instrument designed for the study was distributed to selected staff members of the Department of Industrial and Vocational Education, The University of Alberta, for their review and criticism.

From the recommendations made by these staff members, the research instrument was redesigned, incorporating a number of their recommendations.

The revised copy of the research instrument was then given to a specialist in instrument design from the Department of Educational Psychology, The University of Alberta, for review and analysis of format and question sequence.

Following the recommendations made by this specialist, the research instrument was further refined and used in a pilot study that concerned administrators and industrial arts teachers from junior and senior high schools that would not be involved in the major study.

The purposes of the pilot study were:

1. To determine if there were any ambiguous questions in the research instrument.
2. To determine the correct sequence of questions to be used in the research instrument.
3. To determine if additional questions were needed in the research instrument to collect information relevant to the study.

Following the pilot study, the research instrument was reviewed and revised before it was mailed to participating schools.

The researcher prepared a covering letter that very briefly described the research and its purposes, thus giving participants an overview of the study and their part in it, as well as establishing a deadline for returning the research instrument. This letter, along with the research instrument, was sent to the industrial arts teachers of schools selected to participate in this study.

Following receipt of completed research instruments, the data were analyzed to establish a census of capital equipment found in junior and senior high school industrial arts programmes of participating schools.

From this census, with the most recent vendor's catalogue (1974-75), a cost analysis was made to determine the cost of either replacing or modifying a tool or machine, exclusive of labour costs, used to support junior or senior high school industrial arts programmes of study in participating schools.

From this cost analysis from participating schools, the cost of converting industrial arts laboratories to the SI units of measurement

in the Province of Alberta could be extrapolated.

The results of this study may be used to provide school boards throughout the province with costing information that they may use in turn to determine the cost of converting individual industrial arts programmes at the local level to the SI units of measurement.

References

Canadian Pocket Encyclopedia, The. 28th Edition, Toronto: Quick Canadian Facts Ltd., 1972.

Government of Alberta. Department of Education, Junior and Senior High School, Handbook, 1974-75.

Groner, A. and Boehm, G. A. Going Metric: An AMA Survey Report. New York: AMACOM, 1973.

Feirer, J. L. and Lindbeck, J. R. Industrial Arts Education. New York: Center for Applied Research in Education, 1964.

Ferguson, G. A. Statistical Analysis in Psychology and Education. New York: McGraw-Hill, 1971.

Fowlkes, J. G. and Hansen, A. L. Business Management: "Accounting, Auditing and Reporting," in R. L. Johns & F. L. Morphet (Eds), Problems and Issues in Public School Finance. New York: National Conference of Professors of Educational Administration, 1952.

Leggett, R. F. "Standards in Canada." Ottawa: Information Canada, 1971.

Silvius, G. H. and Bohn, R. C. Organizing Course Materials. Bloomington, Illinois: McKnight & McKnight, 1961.

White Paper on Metric Conversion in Canada. Ottawa: Government of Canada, 1970.

CHAPTER II

REVIEW OF RELATED LITERATURE

Introduction

The first chapter presented an overview of the research, with a brief description of the methodology used. This chapter has three sections. The first section deals with a review of the literature and selected research studies that have been directed at metric education, and have implications for the present study. The second section of this chapter deals with research investigations that were directed at cost analysis in an educational setting. The final section deals with a brief description of the industrial arts programme of study in the Province of Alberta.

Development of the Metric System

History of the Imperial System of Measurement

Recorded history indicates that most cultures have used standards for comparing quantities such as length, weight or time. These early systems of measurement used to establish these standards were based either on the physical attributes of man or on the products of nature. The measures that were derived were arbitrary in their relationship to one another.

Measures were derived from many parts of the body, for instance, the foot, the cubit (length of the forearm), the fathom (length between

fully outstretched arms), the yard (distance from tip of nose to the middle finger of the outstretched hand). The rod was established by lining up heel to toe a random sample of 16 men as they left church. Irwin (1960), in dealing with systems of measurement in early England, wrote:

> ... the furlong was the same length as 10 chainlengths, or 100 armstretches; a 10 acre fold was a square furlong in size. To change that field into 10 fields of equal size the full length would be kept, the separate fields formed from strips a chainlength wide and 10 chainlengths long (p. 27).

Due to a greater accuracy of measurement being required, statutes were formed which imposed standards that produced the framework of the imperial system of measurement. The Bank of Montreal in its Business Review for January 1974, which was directed to the topic "Canada Prepares for Metric Conversion" traced an historical outline of the imperial system of measurement. This brief outline is represented in the following quotation:

> The British Imperial System has evolved as a hybrid of many earlier systems. The Romans, for example, introduced the foot into England where it was integrated with the Anglo-Saxon inch. The inch was originally the breadth of a thumb and remains close to that mark today--if the average Canadian's thumb is any judge. The imperial mile provides a good indication as to how haphazard and arbitrary the adaption of the Roman system was to the British. The mile was defined by the Romans as 1,000 paces or double steps, the pace being equal to five Roman feet. This mile of 5,000 Roman feet became 5,000 English feet, but by a statute, passed under Elizabeth I, it was augmented to 5,280 feet. This served to make the commonly used English furlong (1/8 mile) equal to the then popular rod (660 feet or 220 yards). The yard was earlier decreed by Henry I as the distance from the tip of his nose to the end of this thumb with his arm outstretched.
>
> The formation of the United Kingdom gradually created a uniform system of weights and measures out of the welter of regional systems which included such colourful units as the Stirling jug, the choppin and the Lanark troy. The standard

> units finally agreed upon remained, nevertheless, of a highly obscure and arbitrary nature (p. 2).

Lord Ritchie Calder (1970), in describing the historical evolution of the imperial system of measurement, observed that:

> The folklore of measurement is entrancing. In the Anglo-Saxon measurements that underlie the imperial system the inch was the knuckle of the thumb. The cubit was the distance from the elbow to the end of the middle finger; stated another way it was six palms, the palm being the width of four fingers. The foot was not what one might think: it was originally four palms or 16 fingers, but since there is much variation in the size of human fingers and human feet, the foot was standardized 1,000 years ago as 36 barleycorns 'taken from the middle of the ear'. (Barley also measured weight and volume; a bushel was 50 pounds or eight imperial gallons.) A yard was the distance from the tip of King Edgar's nose to the tip of the middle finger of his outstretched arm. A fathom was said to be the length of a Viking's embrace. An acre was the amount of land that could be plowed in a day by a yoke of oxen. The amount could vary depending on whether the soil was heavy or light. In those days the larger unit was the hide; it too was a variable measurement, being based on the amount of land a yoke of oxen could plow in a year. This amount, which averaged about 120 acres, was deemed enough to support a family.
>
> In medieval Germany the length of the _rute_ (rod, pole or perch) was established by a random sample of 16 men coming out of church: they stood toe-to-heel, and the overall length was accepted as the standard. The Roman legionaries strode out the mile; their _mille_ was 1,000 paces or about 1,618 yards. A pace, however, is a variable unit, and so the mile has varied: the British and American mile was standardized at 1,760 yards, but in a number of European countries the mile ranges from less than a British-American mile to six such miles (pp. 17-18).

Even though standards were developed, the imperial system was considered by scientists and mathematicians to be inconsistent, incoherent and irrational. Mr. J. A. Jeffery, in an unpublished paper, presented to the Department of Education for The University of Alberta, September 1973, pointed out the inconsistency of the imperial system when he said:

> Inconsistent, in that for any physical quantity, such as length, the system has a large number of unrelated units. It is incoherent in that there is seldom a simple relationship between basic and derived units. It is irrational in that there is no single numerical base on which the structure is built (p. 2).

The Metric System

During the time of the French Revolution in 1789 the lack of conformity of measurement came under intense scrutiny in France, so much so that for the first time in history a scientifically reasoned measuring system was devised, the metric-decimal system. Kisch (1965), in his historical outline of scales and weights, states:

> The introduction of the metric-decimal system was unquestionably among the greatest cultural contributions of the French Revolution. After a transition period of a few decades of vacillation between the popular, familiar, and impractical local systems of weighing and measuring and the strange new concept, the latter was made compulsory in France on January 1, 1840. It has subsequently been accepted by the greater part of the civilized world. This unique system, which we owe to French ingenuity and to the energy of its forces, brought to an end the uncertainty caused by metrological disparities (p. 15).

In 1837 the French Government began legislative procedures to standardize its system of weights and measures on a metric base. Leggett (1971) maintains that: "Gradually the new units gained acceptance, to such an extent that in 1869 an international commission met in France to consider the wider adoption of the metric system ... in 1875 the first 'Convention du metre' was signed in Paris ... (p. 50)".

From this Convention the unit of length was to be the metre. The metre was to be calculated as one ten-millionth part of the great circle distance from the north pole to the equator. The unit of mass was the gram, the gram being defined as the mass of one cubic centimetre of water at maximum density.

Leggett (1971), in dealing with the formation of an organization to oversee the metric system, notes that:

> Under the terms of the original Convention du metre, there was established the Bureau International des Poids et Mesures, which has since then provided the necessary technical and research supporting services to the international measurement system... The work of the Bureau is under the general direction of the Committee International des Poids et Mesures--an important group of 18 scientific members from 18 countries--which is the key organization in the metric field... Not only does this Committee nominate the director and the senior staff members of the Bureau, but it also has the privilege and responsibility of calling the governments of all countries that adhere to the Convention du metre to meet in a Conference Generale des Poids et Mesures. This conference must be convened at least once every six years and is the medium through which the adhering countries agree, through their governments, on the exact details of the standards of measurement they will use ... (p. 50).

Since the time of the Convention du metre, several metric systems have been advocated and used throughout the world. Mettler (1972), in an article in the Engineering Digest, produced a brief synopsis of these sytems. In describing these systems, Mettler wrote:

> The original metric system consisted of only three units, the meter (metre), the liter (litre) and the gram, all of which were interrelated, the liter directly derived from the meter, and the gram derived from the liter through the intermediary of water. These three units were used in conjunction with a limited range of decimal prefixes.
>
> The first known attempts to derive further units from the original basic units, and to devise a comprehensive rationalized system, were made in 1863, when the British Association for the Advancement of Science, as a result of the initiative by Sir William Thomson (later Lord Kelvin), proposed an MGS system, based on meter, gram and second.
>
> In 1873, the British Association decided that the meter be replaced by the centimeter (centimetre); although we would now consider this change to have been a backward step, it had long-lasting effects. The result was the well-known CGS system--based on centimeter, gram and second. A few of its units are still in use in North America, for instance the gauss, the maxwell, the centipoise and the centistokes. The

main disadvantage of the CGS system was the fact that some of its units, notably the dyne and the erg, were far too small for most practical uses.

The greatly improved MKS system, based on meter, kilogram and second, made its appearance in 1901, when it was suggested by Professor Giovanni Giorgi of Italy. He also proposed the addition of a fundamental unit of electricity, for which the ampere, the basic unit of electric current, was eventually chosen; it enabled the derivation, in a coherent fashion, of the many electrical units we know today. The resulting MKSA system was for some time also known as the Giorgi system.

The MKSA system was approved by the Conference Generale Poids et Mesures in 1934, at which time two additional basic units, the kelvin for thermodynamic temperature and the candela for luminous intensity, were admitted; they in turn made the further derivation of heat and light units possible.

In 1960, this comprehensive rationalized system consisting of five fundamental or basic units, two supplementary units and numerous derived units was named S.I., which is the internationally current abbreviation of the French Le systeme international d'unites (p. 29).

The United States Department of Commerce report "The English and Metric Systems of Measurement" notes that:

Year (1969)

> Since its inception nearly 175 years ago, the number of countries using the metric system has been growing rapidly. The original metric system of course had imperfections; and it has since undergone many revisions, the more recent ones being accomplished through the General Conference of Weights and Measures. An extensive revision and simplification in 1960 by the then 40 members of the General Conference resulted in a modernized metric system--the International System of Units... (p. 2).

Since 1960, when the Systeme International was accepted, the metric system of measurement has been expanded to seven base units. The base units are for length (metre), mass (kilogram), time (second), electric current (ampere), absolute temperature (kelvin), luminous intensity (candela) and amount of substance (mole).

For the full benefit of a metric system to be realized, it must

be understood by scientists and engineers in all countries. Lighthill (1970) notes that:

> Fortunately, there is an international forum for all scientists and engineers concerned with metric methods of measurement, the CGPM (Conference Generale des Poids et Mesures). The 1954 meeting of the CGPM agreed on one particular detailed form of metric system as a suitable and preferred system for all purposes (p. 48).

The Systeme International therefore provides for consistency, since for any one physical quantity there exists only one unit. All lengths are expressed in terms of the metre, all masses are expressed in terms of the kilogram. The term weight will no longer be used as it has been supplanted by the term mass.

The Systeme International is coherent because of the direct relationship between the basic and derived units. An example of this may be seen in that the unit of area is the square metre, the unit of velocity is the metre per second.

The Schools Council of Great Britain (1970) gives support to the claim of coherency of the Systeme International, when it stated:

> ... the system is coherent in that the units for quantities are the same regardless of the technology. For example, energy, whether electrical, mechanical, or thermal, is measured in joules; power, whatever form it takes, is measured in watts. The SI will, therefore, simplify the learning process and remove some of the pitfalls which at present await the student in our imperial system (p. 9).

Other authorities who have written on the Systeme International units of measure agree that this system of measurement is coherent. Lighthill (1970), in writing on the coherence of Systeme International units of measurement, states:

> A system of units is called 'coherent' if, when quantities are specified in it, the equations representing fundamental laws thus appear without any accidental numerical factors appearing on either side of the equation. The SI system is coherent in this sense (p. 50).

The Systeme International is rational since it permits only one set of multiples and submultiples for all units. In discussing the rationality of Systeme International units of measurements, Leggett (1971) stated: "The Systeme International also provides for uniformity in terminology and mathematical symbols (e.g. 'kilo' is always the prefix for a factor of one thousand...) (p. 52)".

The Present Status of Metric Conversion

By March 1974, 128 countries had officially adopted the metric system, or were in the process of doing so. The combined populations of these countries represent approximately 90 percent of the world's total inhabitants. Many of these countries have adopted the customary metric system which was conceived during the eighteenth century, and is based on the CGS system. With the adoption of the Systeme International as a datum form of measurement, 27 nations have made, or are in the process of making, Systeme International units the only legally accepted system of measurement in their industrial and everyday life.

Great Britain. In Great Britain in 1873 the British Association for the Advancement of Science forecast interest in metric standards when it adopted as British standards the centimetre and the gramme, thus setting the basis for the CGS system of units. With the formation of the Conference Generale des Poids et Mesures (CGPM) two years later, practical measurements involving multiples and submultiples of basic units were derived. This led to the establishment in trade and industry of the metre, the kilogramme, and the second, thereby deriving the more widely employed MKS system of units.

With approximately 60 percent of British exports, in 1964, going

to countries that employed metric standards, the government indicated its readiness to proceed toward a metric system by employing SI units in manufacture, technology and commerce.

Hollis (1970), in dealing with the industrial scene in Great Britain, noted that:

> Mr. Douglas Jay, then president of the Board of Trade, speaking in the House of Commons on 24 May 1965 stated that the Government, in considering the change, felt that British industry on a broadening basis would adopt metric units, sector by sector, until that system became the primary system for weights and measures (p. 61).

The Royal Society (1969) reported the statement on metrication by the Minister of Technology (Mr. Anthony Wedgewood Benn) in the House of Commons, 26 July 1968 (extract from Hansard, 769(164), columns 1167-1171):

> In May 1965, the Government announced their support for the adoption of the metric system of weights and measures in industry which had been proposed by the Federation of British Industries. They also accepted that the metric system would spread onwards from industry and become in time the primary system for the country as a whole. The Government consider that this will bring substantial advantages. More than three-quarters of world trade is now conducted in metric units. All the Commonwealth countries except Canada have changed to the metric system or are about to do so, and studies are in progress in the United States and Canada (p. 52).
>
> The educational system will need to keep pace with, and to some extent anticipate, changes. The conversion will stimulate industrial and commercial modernisation and the rationalisation of production by variety reduction. We must also use it to help our export trade by harmonising our standards with those of our customers overseas (p. 53).

At that time (1965) the target date for effecting the major amount of conversion was set for 10 years ahead - 1975. In a white paper issued in February 1972, the Secretary of State for Trade and Industry reaffirmed the reasonableness of the target date of 1975. In its original declaration the government laid down the policy that costs

of conversion will lie where they fall. The government has adhered strictly to this policy.

Australia. Australia passed the Metric Conversion Act in June 1970, stating as its objective the bringing about progressively of the use of the SI metric system of measurement of physical quantities. A Metric Conversion Board was set up to plan, guide and facilitate a program. At the same time coordination and implementation procedures were to be considered. The announced policy of the government was that the cost of conversion would be borne by those incurring them.

New Zealand. New Zealand established a Metric Advisory Board in 1969, and in April 1970 the government announced approval in principle to converting to the SI metric system of measurement over a seven-year period. A target date was set for conversion by the end of 1976. In New Zealand conversion costs were to be met by those incurring them.

The United States of America. The United States Congress in 1968 passed the Metric Study Act, which directed the Secretary of Commerce to arrange for a broad enquiry and evaluation of the policy choices open to the United States in regard to the possible adoption of the SI metric units of measurement. This resulted in the US Metric Study. The final report (1970) on this study is entitled "A Metric America, A Decision Whose Time Has Come". One of the major recommendations of the report was:

> ... that the United States change to the international metric system through a coordinated, national program over a period of 10 years, at the end of which the nation will be predominantly metric (p. 2).

This report was forwarded to Congress by the Secretary of Commerce. He agreed with the conclusions of the report and recommended

that the government make a firm commitment to the goal of metric conversion. Bills were submitted both in the House of Representatives and the Senate to make effective the recommendations of the report. These bills also recommended a nonmandatory conversion of a period of 10 years. However, the recommendations were not acted upon in the 91st Congress.

Further initiation into the use of the metric system in the United States prompted the Department of Commerce to sponsor metric legislation in the 92nd Congress, in the form of a metric conversion bill (H.R. 11035). The bill as with the other bills, called for a 10-year voluntary changeover to the SI metric system of measurement, coordinated by a metric commission board. It was thought that the bill would have an easy passage through the legislative milieu. But instead, the bill was held up in the House Rules Committee for some four months.

Opposition to the bill came from two groups that feared the potential impacts of conversion. One of the groups was a coalition of three powerful unions: the International Brotherhood of Electrical Workers, the International Association of Machinists and Aerospace Workers, and the United Brotherhood of Carpenters and Joiners of America. Representatives from these unions maintained that workers would require reimbursement of up to $5,000 for buying metric tools. Also it was felt that mammoth retraining efforts would be required, besides the fact that many workers, particularly the older ones might well face obsolescence. The other opposing segment of the community was that of small business associations.

Representatives of these groups, and their lobbyists, prevailed upon congressional leaders to vote down the metric conversion bill

H.R. 11035 presented May 7, 1974; or, to add amendments to the bill so that it would eventually end in defeat. Since the failure of that bill to pass, mainly due to the bill's sponsor adamantly opposing the introduction of amendments to the bill, a continuing dialogue has existed between the administration and interested parties in an effort to revise the legislative proposal.

Shortly after the failure of the metric conversion bill at the House level, an educational bill, H.R. 69, was revised by the United States Senate to include this time metric education. The Senate bill was returned to the House of Representatives (who had approved it without any form of metric provision just prior to the rejection of bill H.R. 11035). The House authorized the addition of metric education to the bill.

Educational amendments to the 1974 Elementary and Secondary Act were signed into law (Public Law 93-380) on August 21, 1974. Special provisions, authorizing the use of $10 million for three consecutive fiscal years were made.

An article in the American Metric Journal, 1974, titled "A Metric System", in dealing with metric conversion states:

> Twelve states have introduced educational bills. Every single one of our (the) states as of this date has metric educational programs in some stage of consideration. Twenty-three states have jointly agreed to teach metric statewide within two years. Georgia and Maine have metrication committees and California is in the process of establishing a state metric conversion commission (pp. 5-6).

On October 30, 1974, the National Association for Metric Education (NAME) was established in the United States. An article in the January-February issue of Metric News, 1975, in covering the formation

of the association and the establishment of its goals stated:

> The foremost goals of the National Association for Metric Education, as outlined in its constitution are:
> 1) to promote the use of the metric system of measurement in all phases of education, industry, commerce and government.
> 2) to establish and maintain high standards for the teaching of the metric system at all levels of education.
> 3) to cooperate with existing research activities that seek to educate toward metric usage and to provide an effective medium for individuals, organizations, professional associations and governmental agencies engaged in the development of metric education programs for school systems and for the general public.
> 4) to provide civic leaders and officials of federal, state and local governments with guidelines for their independent efforts in the national conversion to the metric system of measurement.
> 5) to assist in the education of housewives, union members, retail trade workers, corporation executives and employees, and the like, to the simplicity and uniformity of the metric system through the electronic and printed media (p. 15).

By the utilization of these goals the organization aims to provide the high quality guidelines and instruction that are required to smooth the way for a metric changeover in all sectors of the nation's society.

Canada. In Canada, the government, through the offices of the Honourable Jean-Luc Pepin, Minister of Industry, Trade and Commerce, issued a white paper in January 1970. This white paper enunciated the following broad principles:

> 1. The eventual adoption in Canadian usage of a single coherent measurement system based on metric units should be acknowledged as inevitable and in the national interest.
> 2. This single system should come to be used for all measurement purposes required under legislation, and generally be accepted for all measurement purposes.
> 3. Planning and preparation in the public and private sectors should be encouraged in such a manner as to achieve the maximum benefits at minimum cost to the public, to industry, and to government at all levels (p. 8).

By an Order in Council, the government in June 1971 established the Preparatory Commission for Metric Conversion, which is referred to

as the Metric Commission.

The Commission was instructed to investigate the implications of conversion to the SI metric system. It was to prepare an overall plan for conversion, coordinating the process in the different sectors of the economy so as to effect the change at the lowest cost consistent with obtaining the best advantage to Canada. The Commission was at the same time asked to advise the Minister on the need for legislation or other action to facilitate the conversion.

The Metric Commission is made up of 17 commissioners. Each commissioner was selected to represent a sector of the economy, both industrial and nonindustrial, being drawn from different geographical areas of Canada. These commissioners are representative of the main language groups. The Commission has established steering committees, each responsible for planning and coordinating within a particular sector of the economy.

Each steering committee has assigned to it a permanent member of the Commission staff as a sector plan manager. One of those steering committees is concerned with education (Figure 1). The sector plan manager is responsible for assisting in the organization of sector committees and in arranging the prosecution of the committee's work, be it associated with primary, secondary, post-secondary, non-university, university education or training.

The Chairman of the Metric Commission, in addressing the Alberta Invitational Conference on Metric Conversion (Edmonton, October 17 and 18, 1973), stated that: "Education in the formal sense is a provincial responsibility. The commissioner's task is to provide the information

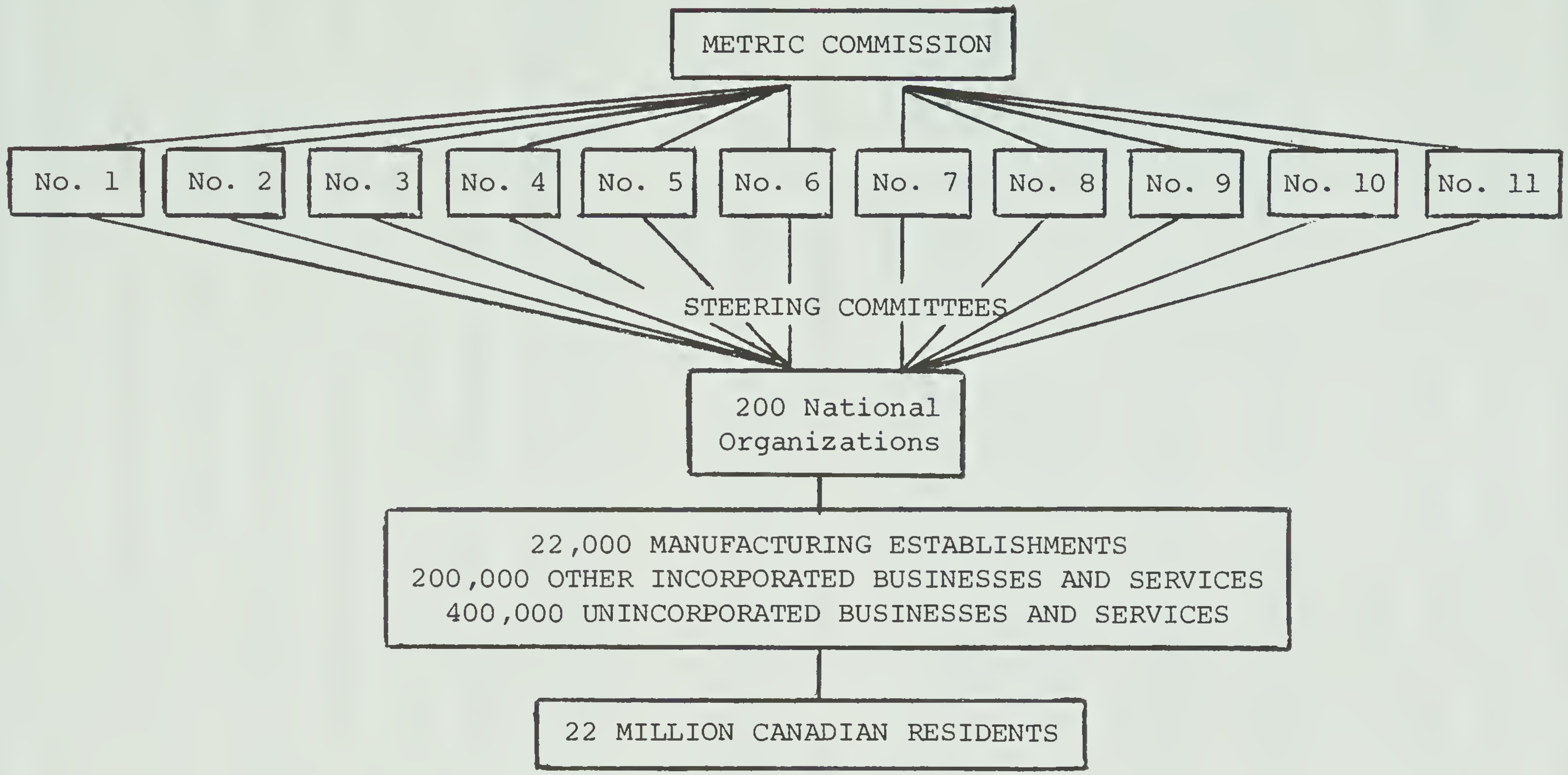


FIGURE 1

METRIC CONVERSION INFORMATION FLOW CHART

that will enable the provinces to coordinate their planning (p. 9)".

The responsibility for education as a provincial jurisdiction was given to each of the provinces by federal mandate when the British North America Act was enacted in 1867. Ollivier (1962), in making an analysis of the British North America Act, provided the following direct quote from the Act as it pertains to education:

> In and for each Province the Legislature may exclusively make Laws in relation to Education, subject and according to the following Provisions:
> 1. Nothing in any such Law shall prejudicially affect any Right or Privilege with respect to Denominational Schools which any Class or Person have by Law in the Province at the Union.
> 2. All the Powers, Privileges, and Duties at the Union by Law conferred and imposed in Upper Canada on the Separate Schools and School Trustees of the Queen's Roman Catholic Subjects shall be and the same are hereby extended to the Dissentient Schools of the Queen's Protestant and Roman Catholic Subjects in Quebec (p. 87).

With the responsibility of conversion to SI units of measurement placed in the hands of the provinces, clearly careful planning of this change is necessary.

Present Status of Conversion to the Metric System in Canadian Education

Part of the information of this section that is directed at what position the various provinces have taken with reference to metric conversion in education was secured from a personal interview with the Sector Plan Manager of the Metric Commission, Ottawa. This interview was held in Edmonton during April 1975.

Of the steering committees dealing with the various aspects of the Canadian economy and society, the tenth deals with education. Steering committee number 10 is chaired by a Commissioner of the Metric

Commission. The committee is composed of members of the various associations in the field of education such as the Canadian Teachers' Federation, the Home and School and Parent-Teacher Federation, the Canadian Vocational Association, the Canadian Adult Education Association, the Canadian School Trustees' Association, the Association of Universities and Colleges of Canada, and the Association of Community Colleges. This committee acts as a liaison between the Commission and the individual provinces.

Nova Scotia. Nova Scotia has set up an interdepartmental committee on metric conversion through the Nova Scotia Department of Education. This involves adult education, curriculum officers, teacher training people, vocational training, technical training and in-section services.

Two *ad hoc* committees, one on primary and one on secondary education, report to the interdepartmental committee. The committee on primary education has developed a teacher training workshop. Nova Scotia decided to start teaching the metric system as of September 1974 in primary grades 1 and 2 and grades 7 and 8. This is to continue in 1975, when the program will be expanded to include grades 3, 4, 5, and 6.

Newfoundland. In October 1974, a metric education consultant was appointed by the provincial government. The consultant has been charged with the responsibility to prepare a plan of the implementation of SI metrics to start in the primary grades. This plan of action is to be ready for September 1975.

New Brunswick. An interdepartmental committee on metric conversion has been established to guide and oversee the implementation of SI

metrics in the province. Implementation was planned for grade 7 in February 1975, with additional programs planned for grades 4-9 in September 1975 and grades 1-3 in September 1976. Further, supplementary texts are being made available to teachers to assist them in teaching SI. Teacher training in SI metrics is now available and is being used in institutions where teachers receive their pre-service preparation.

Prince Edward Island. The secretary to the Cabinet plans to submit a motion to the Cabinet giving official sanction to metric conversion. It is hoped that this will incite government departments into more specific action. Teachers are being provided with a measurement booklet, to aid them in the teaching of the metric system.

In more specific terms, implementation of SI metrics is planned for grades 6-9 (1976), grades 1-2 (1977), grades 3-4 (1978), and grades 5-6 (1979).

Quebec. Interdepartmental committees on metric conversion are in the process of being struck in Quebec. In the Department of Education program directors were asked to identify the problems they foresaw in the in the field of metric education. Metric education is expected to start at the primary level, permeating through eventually to the secondary, college and university levels.

Proposed implementation allows for an introduction to SI metrics according to the following timeline: grades 1-3 and grades 8-10 (1975-76), grades 4-6 and grades 11-12 (1976-77). It is expected that by 1977-78 all students in elementary and secondary grades will have acquired a basic knowledge of SI metrics.

Ontario. In Ontario the Ministry of Education for the province

has set up a task force on metric education. Guidelines dealing with all aspects of life in a metric world are being prepared. These will be directed toward teachers of all subjects. It is hoped that once Ministerial approval has been granted, these guidelines will be released to all school boards. Besides this, the Ministry of Education in Ontario is stressing teacher training in order to introduce metric education at a later date. This would be completed over a period of four to five years.

In terms of the various school boards, each school board is progressing as it sees fit. The aim is that the school in general will be predominantly metric by the end of the 1977-78 scholastic year.

Manitoba. In Manitoba the government has established an elaborate structure for conversion to the metric system. An interdepartmental committee called Standards and Metrication (SAM) meets once a month. The Department of Education has its own metric committee which deals with schools. The committee acts as a facilitator for metric conversion. The department has prepared and published a workshop for teacher training called An Introduction to the Metric System (1973). An extensive training program took place in the latter part of 1973 in order that the metric system might be introduced into the schools in January 1974 from kindergarten to grade 6. Implementation for grades 7-8 is planned for September 1975.

Manitoba also has a metric committee for community colleges, representing the three community colleges in that province. Each community college in turn has a metric committee to oversee the implementation of plans developed by the central college committee.

Saskatchewan. In Saskatchewan a metric conversion curriculum is past the embryonic state, incorporating schools, administrators and other interested parties. Concrete developments have been formalized and the province hopes to implement a planned program for SI for grades 1-3 in September 1975, grades 4-6 in September 1976, and grades 7-12 in September 1977. Teacher training in SI metrics is now in progress.

British Columbia. In British Columbia metric measurements have been introduced in grades 1, 2 and 3. The provincial program called for the introduction of metric measurements into the curriculum for grades 4, 5 and 6 in September 1974. Grades 7 and 8 have programs planned for implementation in September 1975 and September 1976 respectively. Total conversion to SI units of measurement in the school systems is expected to take five years. The British Columbia government has expressed an official commitment to go metric.

Alberta. Some major activities have been undertaken, and others are in the planning stage with respect to metric conversion in Alberta schools.

In November 1973, the Curriculum Branch of the Alberta Department of Education sponsored a two-day Conference on Conversion to the Metric System. Invitations were issued to representatives of the Department of Education, The Alberta Teachers' Association, the Alberta School Trustees' Association, The Conference of Alberta Superintendents of Schools, the Federation of Alberta Home and School Associations, urban school boards, and faculties of education. The conference was primarily designed to create an awareness about conversion to the metric system, and to explore alternatives with respect to the policy and program

implications of conversion to the metric system. Proceedings of this conference have been published and distributed to invited participants.

An important recommendation that resulted from that conference was that a committee or a task force be established primarily to organize and implement activities pertaining to conversion to SI units of measurement.

Planning committees have been established by various school boards with regard to converting their measurement system to SI metrics. Mr. Melnychuk, supervisor for mathematics, Edmonton Public School Board (EPSB), and head of this school board Metric Committee stated in a telephone conversation (April 1, 1974) that, "The school board offered an 'awareness week' for school administrators during March. Further, the EPSB has struck a Metric Committee for the purpose of:

- producing a systematic development of metric conversion awareness, both for students and general public.
- producing lists of equipment that will necessitate change. This, it is hoped, to be completed prior to the striking of the school board budget.
- producing materials applicable to metric conversion charts, learning aids, etc. These are to be used in pilot schools within the school system".

The Calgary Public School Board (CPSB) has established a Metric Committee. This Committee, which represents subject areas at all levels, as well as administrators, with representation from the school board, is headed by the Coordinator for Curricula Implementation. Mr Len Hall has been employed by the CPSB for a period of three years to fulfill the

role of Coordinator. This Committee has an operational budget of $100,000 over the three-year period with which to look into such areas as:

- teacher in-service
- audio-visual materials
- public awareness
- curricula change

besides the various items of equipment that will require change.

Metric Planners with the Alberta Department of Education expect that conversion will peak in the schools of Alberta during the three-year period between 1975-78. During this timeframe it is anticipated that classroom implementation will take place as teachers are trained and schools are equipped.

More specifically, the aim of the Department of Education is that 80 percent of the introduction to the SI metrics will be completed by June 1978.

A member from the Department of Education served as a liaison member to the Metric Task Force of the Council of Ministers of Education, Canada. The purpose of this task force is to coordinate metric conversion among the provinces so that conversion is a coordinate effort.

At the time of the study this task force had as one of its major responsibilities the design and development of a Style Guide for the Education Sector.

Cost Analysis

Public school costs in Canada have greatly increased during the years since World War II. Of the years between 1945 and 1965, it was estimated that the average increase in educational expenditures was 13.5 percent, while, "... as a proportion of the Gross National Product, educational expenditures have risen two and one-half times in the same period (Financing Education, 1962, 12)". In 1967, 7.3 percent of the Canadian GNP was found to be attributable to education (Commercial Newsletter, 1968, 2).

Indicators suggest that this trend of rapidly increasing expenditures for education will continue growing. The National Education Association, in its publication What Everyone Should Know About Education (1966), stated that "substantial increases for schools and other educational institutions and agencies are both necessary and wise (p. 57)". To supplement this, Hanson (1969) predicted that, "... expenditures in education in Canada will continue to increase substantially during the 1970's (p. 1)". These increases in educational expenditures have resulted in increased interest and surveillance by the public, as is witnessed by recent reportings within the mass media.

Due to the rising costs and increased public interest, two conditions result. Firstly, that all available financial resources must be astutely investigated and secondly, that all educational expenditures must be accurately summarized and analyzed, thereby allowing the results to be meaningfully reported to the educational system as well as to a much concerned public. Such a procedure would imply the utilization of a sound and valid financial accounting principle and procedure.

Mort, Reusser and Polley (1964) point out that, "accurate analysis of cost is essential to effective control of the educational enterprise and is an aid in explaining the work of the schools to those who are interested (p. 40)". Burke (1957) realizes the importance of cost analysis when he states: "The first step of a program budget consists of a rigorous analysis of the organization ... (p. 96)". This analysis in turn may then culminate in the formation of objectives to be expressed in operational terms. Then after a suitable program structure is developed, resources may be allocated and budgetary dollars assigned. A major result of this process is the Planned Program Budget System (PPBS), which is a multi-year program document and financial plan for the respective organization.

Cost Analysis Defined

The following definition of cost analysis was given as an operational definition in Chapter I:

> Cost analysis is the process of studying the total cost of public education for a given community, state, or area for a given year; trends in total school costs; the costs of specific services or subjects, e.g. transportation or English; the cost of education by grades or levels, e.g. elementary school costs, secondary school costs; cost of maintenance; cost and bargaining abilities; cost and size of school; reasons for increased costs and need for decreased costs.

Explicit in this definition are a number of uses for cost analysis in an educational environment. Initially, cost analysis attempts to measure the amount of expenditure for programs, preferences, activities or outputs based on a standard measurable unit. These unit costs are then analyzed in the light of existing conditions and objectives and output of the school system. The analyzed results are then used as a basis

for the improvement of programs and administrative procedures.

Within the context of this study, unit cost analysis refers to the detailed determination of educational expenditures to be encountered through the change from imperial systems of measurement to metric systems of measurement within the framework of industrial arts.

Significance of Cost Analysis for Educational Expenditures

The increase in public interest and possible alarm experienced in the realm of educational expenditures has been illustrated in numerous accounts in the public media. Knezevich and Fowlkes (1960) maintained that: "Public school costs have continued to rise at a fairly rapid rate during the years following World War II. The interest of the public in educational costs has never been greater (p. 152)".

The results of cost analysis can be of value in allocating funds for educational spending. It is therefore important to educationists that expenditures for educational purposes result in the greatest possible return. Van Ren Haag (1956) offers some fundamental rules that are directed toward educational investment.

The fundamental rules for investment (including investment in education) are:

> As long as an additional investment yields net returns (returns exceeding its costs) it is desirable; when the net returns on one investment exceed net returns on alternative investments it is to be preferred, for this indicates that more highly valued services can be rendered by this allocation. When all additional investments yield the same return, optimum allocation has been achieved (p. 11).

In dealing with the optimum returns for educational investments to be experienced by cost analysis, Fowlkes and Hansen (1952) felt that:

> Maximum educational opportunity within limits of financial ability and a reasonable guarantee of operating efficiency that obtains, as nearly as possible, maximum value per dollar spent for public education might well be adopted as a working charter for all those responsible for business management of public education. Such a charter can be maintained, only if financial accounting systems for schools are such that cost analysis of the type suggested can be made (p. 472).

It becomes evident that unit cost analysis provides information that in turn assists in the investment of limited educational funds. Cost analysis is a tool to be utilized by school boards, teachers and school administrators as decisions are made to spend the funds mandated to them by the public.

This assistance allows for the development and maintenance of an adequate educational program, especially applicable in an educational environment where change is constant. The fundamental purpose of cost analysis, according to Knezevich (1967), is, "to present and interpret cost data as an aid to administration of public education (p. 204)". Vaizey and Chesswas (1967), in advocating the use of cost analysis, state: "There is no administrator in the world who has more resources than he can use; and when resources are limited, choices have to be made. It is essential that these choices are based on an accurate assessment of the cost situation (p. 11)". Cost analysis data can provide the public and educational personnel with an accurate picture of costs per course, program, grade, school or system. This information may then be used as a basis for evaluation of existing programs.

Of paramount importance is the assistance cost analysis can give in the preparation of school budgets, especially for these activities which can be reduced to measurable units. Ovsiew and Castetter (1960) wrote the following in discussing the importance of cost analysis in

budget preparation: "... detailed and accurate cost accounts can reduce the time and labour needed in budget preparation by 90 percent (p. 287)".

Industrial Arts in Alberta

Prior to 1963 industrial arts in Alberta was organized on a unit shop basis with woodwork, metalwork and drafting the predominant courses taught. During the latter part of 1963 the Department of Education established an industrial arts curriculum committee. The committee was made up of in-service industrial arts teachers, the Supervisor of Industrial Arts from the Department of Education, and professors from the Department of Industrial and Vocational Education, The University of Alberta.

The committee was charged with the responsibility of developing a curriculum that would move away from the organizational pattern of the unit shop for industrial arts, and replace it with the multiple activity laboratory.

The rationale for making this decision was that for industrial arts to be a viable programme, the concepts inherent in a productive society must be taught if the learner is to develop the correct technological orientation to the productive aspects of society.

The multiple activity programme was introduced as an integral part of general education, and was considered to be part of a synthesizing educational process that would serve as a reinforcement to the academic disciplines. In the industrial arts laboratories the students in the materials areas would be involved in learning activities by making a product as a learning vehicle. Students in the technology areas who approach an experiment from the general to the specific, would move from

a general system, to the units of the system, to the component that makes up the system. They then analyze the components to determine the application of scientific laws, principles and theories involved in the component. This redesigned industrial arts programme is referred to as the "Alberta Plan".

Cochran (1970) in his book, Innovative Programs in Industrial Education, wrote the following statement when he was discussing the "Alberta Plan" as one of the 32 innovative programmes in industrial arts. He had this to say:

> The program is designed to make an articulate contribution to general education at the secondary school level through the achievement of four major objectives:
>
> 1. To provide an environment where students can reinforce and apply the academic disciplines.
> 2. To provide exploratory experiences in the various productive aspects of society.
> 3. To provide a synthesizing educational environment.
> 4. To provide an introduction to the multiplicity of career opportunities (p. 75).

The Alberta Plan is made up of four phases which are sequentially taught from grades 7 to 12, and range from an introduction of tools, machines and processes used to make, shape and form materials; to an introduction to the basic technologies that are normally found in a productive society. In the upper senior high school grades, the students do an in-depth study of a selected cluster of technology or material courses.

In describing each of the four phases of the Alberta Plan, Cochran wrote the following on Phase I which is designed for junior high school students in grades 7 and 8.

> Phase I is designed to introduce seventh grade boys and girls to tools, machines, and materials in a multiple activity program. This aspect has an organizational structure similar

> to many conventional programs as experiences are provided in plastics, electricity, graphic arts, woods, metals, and ceramics. While projects (referred to as products in the plan) are used, they are presented in a predetermined manner to obtain optimum learning experiences in terms of the stated objectives. They provide the student with a realistic opportunity to appreciate the limitations of tools, machines, and materials.... Similar activities are provided in the other areas; however, it must be remembered that these are simple in nature since their sole purpose is to serve as introductory units. Each activity is also accompanied by a description of the most prevalent industries within the area, occupational opportunities, and knowledges and skills needed to enter the field (p. 75).

Phase II of the Alberta Plan is normally for students in grades 8 or 9. These students learn about the basic technologies of a productive society. Cochran describes this phase of the Alberta Plan in the following manner:

> In Phase II at the eighth and ninth grade levels, the students are introduced to the various technologies prevalent in the world of work. Since technology is based on an application of science, the learning activities in this phase are planned to reinforce the academic disciplines and delineate clearly the interdependence of the technologies.
>
> The major technologies studied include power; graphic communication; testing; mechanical, electronic, power transmission; and computer technologies. As work is done within a multiple activity environment, use is made of programed learning, prototypes, experiments, and 'bread-board' models, while most prominent industries, occupational opportunities, and preparation for these occupations are identified.
>
> Numerous activities are covered in these technological areas so the student may develop an awareness of the need for scientific knowledge when making industrial applications (p. 75).

Cochran further provides the following description of Phase III of the Alberta Plan, the stage at which students at the high school level are introduced to the programme.

> At the tenth grade level Phase III provides educational experiences that expose students to the role of man and the technological demands imposed upon organizations. Simulated

> industrial situations are employed which focus upon organizational structures, decision making, communications, and authority configurations.... Such functions as line and staff requirements, quality control, and union representation are covered (p. 76).

The fourth phase, Phase IV, is for senior students at the secondary school level. The following is the manner in which Cochran describes Phase IV of the Alberta Plan.

> Phase IV at the eleventh and twelfth grade level provides an opportunity for independent study and research activities. The student pursues two or three (or a combination) of the basic technologies surveyed earlier. The development and experimentation with prototype projects is emphasized throughout this phase. The total resources of the school and community are used to provide optimum learning experiences at this level (p. 76).

Harder (1968) in his article, "The Alberta Industrial-Arts Program", presented a thorough description of the industrial arts curriculum that was recommended by the provincial Department of Education. In this release, Harder stated "... the Alberta curriculum in industrial arts spans six years of public school starting in seventh grade. During the first three years (grades seven through nine), students study a minimum of three different units each year (p. 54)".

In further describing these units he said:

> Each of these units is 30 hours in length and may be chosen from the following: power mechanics, electricity, electronics-computer, metals, wood, plastics, ceramics, graphic communications, graphic arts, and one of industrial crafts (art metal, leather, lapidary) (p. 54).

According to this writer each area of the multiple activity laboratory is referred to as a "bay" and can accommodate from four to five students. In each of these bays there are the machines, tools and materials required by the students in working with a material or process. This states Harder, "... is known as a 'multiple-activity' organization

for learning (p. 54)".

Harder in outlining the industrial arts programmed at the senior high school level (a continuation of the programme just delineated) said:

> ... At the senior-high school level (grade 10 through 12) there are two programs to choose from: one is called 'general' and the other 'cluster'.
>
> Industrial Arts General 10, 20, 30 - For those students who attend a school with limited industrial-arts facilities, the general program is most suitable. Content is broad in scope and extends the knowledge obtained in the junior high school. This course can also be used by students who wish to continue with vocational courses following grade 10....
>
> Industrial-Arts Clusters - The second program at the senior-high-school level is called the 'cluster' program. The courses provide time to gain greater depth in a field consisting of closely related technologies. These clusters are built around four major areas:
> (1) Electronics - electricity, electronics, computer
> (2) Materials - wood, metals, plastics, earths
> (3) Graphic Communications - drafting, printing, photography, lithography
> (4) Power Mechanics - power source and transmission (p. 56).

In his article, Harder made a brief reference to the use of the media as part of the instructional delivery system when he wrote, "The contents of the units are highly structured through the use of instruction sheets, manuals, and audiovisual materials (p. 56)".

References

__________. "A Metric System." American Metric Journal November/ December, 1974. (pp. 5-6)

Burke, A. J. Financing Public Schools in the United States. New York: Harper & Brothers, 1957.

__________. "Canada Prepares for Metric Conversion." Business Review (Bank of Montreal) January, 1974. (p. 2)

Cochran, L. H. Innovative Programs in Industrial Education. Illinois: McKnight & McKnight, 1970.

Fowlkes, J. G. and Hansen, A. L. "Business Managment - Accounting, Auditing and Reporting," Problems and Issues in Public School Finance. Edited by Johns, R. L. and Morphet, F. L., New York: National Conference on Professors of Educational Administration, 1952.

Hanson, Eric J. Financing Education in Alberta. Research Monograph No. 14. Edmonton: The Alberta Teachers' Association, March, 1969.

Harder, J. D., "The Alberta Industrial-Arts Program," School Shop November, 1968, Vol. 28, pp. 53-58.

Hollis, W. S. "The Industrial Scene," Metrication. Edited by F. W. Kellaway, Middlesex, England: Penguin Books Ltd, 1970.

Irwin, K. G. The Romance of Weights and Measures. New York: The Viking Press, 1960.

Jeffery, J. A., "Metrication." Unpublished paper presented to The Department of Education, The University of Alberta, September, 1973, p. 12.

Kisch, B., "Scales and Weights (An Historical Outline)" New Haven: Yale University Press, 1965.

Knezevich, S. J. Resources Management and Educational Logistics. The Theory and Practice of School Finance. Edited by W. E. Gauerke and J. R. Childress. Chicago: Rand McNally & Company, 1967.

Leggett, R. F., "Standards in Canada." Ottawa: Information Canada, 1971.

Lighthill, M. F. "Metrication in Science and Technology," Edited by F. W. Kellaway, Middlesex, England: Penguin Books Ltd., 1970.

__________. "Metric Education Association Formed." Metric News. January/February, 1975, Vol. 2, No. 3, p. 5.

Mettler, A. J. "The Metric System." Engineering Digest. June, 1972.

Mort, P. R., Reusser, W. C., and Polley, J. W. Public School Finance: Its Background, Structure and Operation. New York: McGraw-Hill Book Company, Inc., 1964.

Ollivier, M. "The British North America Acts and Selected Statutes 1867-1962." House of Commons. Ottawa: Queen's Printer and Controller of Stationary, 1962.

Osview, C. and Castetter, W. B. Budgeting For Better Schools. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1960.

Schools Council, "Measure For Measure: A Guide to Metrication for Workshop Crafts and Technical Studies." London: Evans Brothers, 1970, p. 9.

__________. "The English and Metric Systems of Measurement." United States Department of Commerce. Washington: U.S. Government Printing Office, 1969, p. 2.

The Royal Society, "Metrication in Schools II." Report on Conference on September 19, 1968. London: The Royal Society, January, 1969, pp. 52-53.

United States Metric Study. "A Metric America, A Decision Whose Time Has Come." A Report presented to Congress, 1970, p. 2.

Vaizey, J. and Chesswas, J. D. The Costing of Educational Plans. Italy: Unesco-International Institute for Educational Planning, 1967.

White Paper on Metric Conversion in Canada. Ottawa: Government of Canada, 1970.

CHAPTER III

METHODOLOGY

Introduction

It will be recalled from Chapter I that the purpose of the study was to determine metric conversion costs for industrial arts programmes of study in the Province of Alberta. More specifically, the study sought to determine replacement costs of tools used in the materials and technology areas normally found in industrial arts, as well as modification costs of machines used in the materials and technology areas. An overview of the methodology used to bring this study to a successful conclusion was presented as part of that chapter.

The second chapter dealt with a review of the literature and selected research studies directed at SI units of measurement. This encompassed the development of the metric system, the metric system itself, the present status of the metric conversion in countries presently adopting SI units of measurement, specifically Canada. Further, Chapter II dealt with cost analysis in a general term of reference, and a brief description of industrial arts in Alberta.

This chapter will describe in greater detail the methodology from Chapter I that was used to collect the necessary data for analysis. It includes also a description of the instrument that was designed, and used to collect data for analysis. The analysis of these data will be presented in Chapter IV.

Developing the Instrument

From an extensive library research of the standard indices that

report the findings of studies conducted in educational research, it was found that no study had been conducted that was as extensive as the one being reported.

Many of the studies reported in these indices centered around the teaching of what is now known as technical metrics, or MKS metrics - millimetre kilogram and second, and were completed in the United States. These studies were completed prior to the revision of the MKS by the Committe International des Poids et Mesures in 1960 into the SI units of measure.

To determine if research on the topic of cost of conversion for industrial arts programme of studies had been completed by researchers in other countries of the world that were undergoing, or had recently completed metric conversion, correspondence was initiated with either a metric commission or board in these countries (Appendix A, page Responses that were received to this correspondence indicated that single school districts had looked at this problem on the basis of a single school only and not on a system-wide basis.

Because of the lack of previous research studies directed at the cost of metric conversion for industrial arts, the researcher had to design an instrument that would yield data for determining a census of equipment that would be affected by conversion. This approach was taken because no other instruments were available that could be used as a model on which to build.

In the Province of Alberta, the Department of Education have minimum equipment lists that are used for equipping industrial arts laboratories. These equipment lists are made available to school

districts that may wish to establish an industrial arts programme of studies. To secure copies of these equipment lists, the researcher initiated correspondence with the Consultant in Industrial Arts of the Department of Education, requesting a copy of the equipment list for both the materials and technology areas.

Also requested in this correspondence was a list of school jurisdictions in the province that offer a programme of studies in industrial arts. Both the equipment lists and the list of school jurisdictions were readily supplied.

Using the equipment lists that were received, items that would be affected by metric conversion were identified by the researcher. These items were then extracted from each equipment list and a new list generated. The extracted list became an integral part of the first draft of the research instrument. Table 1 is a sample entry from this list for the metalwork hand tools section of the materials area.

A more complete copy of this research instrument in its final form may be found in Appendix B, page 114.

Prior to being used in the pilot study, the first draft of the proposed research instrument was reviewed by selected personnel from the Department of Industrial and Vocational Education, of the Faculty of Education, of The University of Alberta. Utilizing comments and recommendations made by these reviewers, the research instrument was redesigned. The redesigned instrument was then reviewed by a specialist in instrument design from the Department of Educational Psychology, of the Faculty of Education, of The University of Alberta, before being used in the pilot study. From this review it was found that the question sequence

TABLE 1

SAMPLE ENTRY FROM FIRST RESEARCH INSTRUMENT

FOR METRIC CONVERSION COSTS

METALWORK HAND TOOLS	NUMBER ON HAND
Micrometer - 1" (B & S #599-4)	
Rules - 6" Steel	
Rules - 12" Steel	
Square - Combination 12" (Stanley #H1222 1/2)	
Square - Combination Set - 12" steel rule, centre head, protractor head (Miller Falls 1274)	
Squares - Tri 6" (Stanley #12TS)	
Tap and Die Set - Machine, Screw up to 5/8" NC-NF (Butterfield)	
Tape - 10'	
Wrenches - Set-Allan Long Stem 5/64"-3/8"	
Wrenches - Set-Combination 1/4"-7/8" in 1/16"	

had to be modified and certain introductory pages of the instrument eliminated.

The Pilot Study

The redesigned instrument was used in two schools that were selected to be involved in the pilot study, and that were not part of the major investigation.

One school that was selected was a junior high school. This was an urban school that had a population of 350 industrial arts students. In this school industrial arts served both grade 8 and grade 9 students. There were two industrial arts teachers, one to teach the materials

area, the other to teach the technology area. A senior high school was selected as the other school. Within this school 320 students took industrial arts during the second semester. The areas offered by the programme were materials, mechanics, graphic communications, and electronics. Each of the four teachers was responsible for teaching a specific area in the industrial arts laboratory.

The purpose of the pilot study was to determine whether pilot study participants could interpret the statements in the instrument, and to have the participants identify additional tools or machines that would be affected by conversion to SI units of measurement.

The results of the pilot study indicated that the teachers involved could readily interpret statements on the research instrument. Teachers involved in this phase of the study did not identify additional items that would be affected by conversion.

In the major investigation the final draft of the research instrument used in the pilot study was produced and posted to each of the schools selected to participate in the major investigation.

The Population and Sample

The population of schools offering industrial arts programmes of study was obtained from the office of the Consultant in Industrial Arts of the Department of Education for the Province of Alberta. This list identified 311 junior high schools; junior-senior high schools; and senior high schools in the province that offer industrial arts programmes of study for their students.

<u>The Sample</u>

From the population of 311 schools, where industrial arts programmes of studies are offered, the sample for the study was selected. In selecting this sample, the researcher chose 25 schools. To obtain this number, the population was stratified as follows: junior high school, senior high school, where the ratio of junior high school to senior high school was that of 2:1. These schools were further stratified into the following classifications, urban and rural. From these two stratified samples a random sample was taken until the ratio of urban to rural schools was 2:1. The random sampling was conducted by following the procedure for establishing a stratified random sample as recommended by Ferguson (1971) in <u>Statistical Analysis in Psychology and Education</u>, p. 122.

Data in Table 2 indicate the make-up of the sample (which was 25) established from the population.

Eighteen of these school were classified as junior high schools, 16 of which were from urban areas and two of which were from rural areas. The remaining seven schools were classified as senior high schools, six of which were located in rural areas. Only one senior high school was located in an urban area.

To validate the sampling procedure, an expert in population and sampling techniques from the Department of Educational Psychology, of the Faculty of Education, of The University of Alberta, was consulted. This individual fully agreed with the procedures used in selecting the sample for the study.

TABLE 2

TYPE OF COMMUNITY AND SCHOOL CLASSIFICATION

FOR SCHOOLS COMPRISING RESEARCH SAMPLE

TYPE OF COMMUNITY	SCHOOL CLASSIFICATION		TOTAL NUMBER OF SCHOOLS
	JUNIOR HIGH	SENIOR HIGH	
RURAL	2	6[a]	8
URBAN	16	1	17
TOTAL	18	7	25

[a]Three of these schools were junior-senior high schools but for this research study were designated as senior high schools. This will be described in detail in a subsequent section of this chapter.

Administering the Instrument

One of the regulations of the Department of Education of the province for involving in-service teachers in educational research is to receive the approval of the employing superintendent. To secure approval from these employing administrators to involve their teachers in the study, a letter was mailed to each school's official. The only purpose of this letter was to secure the superintendent's permission to allow the industrial arts teachers of the district to participate in the study. For ease of response, a self-addressed envelope was enclosed with this letter. A sample copy of this letter can be found in Appendix C, page 130.

Affirmative responses were received from all of the superintendents. After receipt of these replies, the final draft of the research instrument and a covering letter were mailed to each of the industrial arts teachers employed in the participating schools (see Appendix D,

page 133 for a listing of these schools). The covering letter explained the purpose of the study, the objectives of the study, the deadline for the return of the completed instruments, and the role that the teacher would have in the investigation. Also included in this mailing was a self-addressed stamped envelope for the return of the completed instruments. A sample copy of this letter can be found in Appendix D, page 133.

Twenty-five instruments were mailed to industrial arts teachers in the 25 schools selected to participate in the study. Fourteen of the 25 teachers contacted returned completed instruments by the deadline date established in the covering letter. To increase the rate of return, a follow-up letter was mailed to those teachers who did not submit their instruments by the deadline date. The reader is asked to turn to Appendix D, page 133, where a sample copy of the follow-up letter can be found.

Following this procedure an additional eight completed instruments were received for analysis. This represented an 88 percent return from those who were asked to participate in the study. Data in Table 3 show the number of returns received from the 25 schools identified for the research.

Profile of Participating Schools

The information that is presented in this section of the report was collected by questions asked on the School Profile Information Sheet. The questions on this sheet dealt with the type of school where participating teachers taught, the type of community where the school was

TABLE 3

NUMBER OF RETURNS RECEIVED FROM

THE PARTICIPATING SCHOOLS

TYPE OF COMMUNITY	SCHOOL CLASSIFICATION		TOTAL NUMBER OF SCHOOLS
	JUNIOR HIGH	SENIOR HIGH	
RURAL	2	4	6
URBAN	15	1	16
TOTAL	17	5	22

located; the student enrolment of the school; and the grades that teachers who participated in the study taught.

A School Profile Information Sheet was included with each research instrument mailed to participating schools. A copy of this information sheet is part of the research instrument and can be found in Appendix B, page 114.

Type of School

The first question on the School Profile Information Sheet asked the participants to identify the type of school where the participants taught. This information is presented in Table 2, page 53.

Data in Table 2, page 53, show that of the 25 randomly sampled schools, selected to participate in the study, 18 schools were placed into the category of junior high schools and seven were categorized as senior high schools. Of these seven senior high schools, three were actually junior-senior high schools because both used the same laboratory for instructional purposes. They were for the intent of this study

designated as senior high schools.

Type of Community

In the second question on the School Profile Information Sheet the participating teachers were asked to identify the type of community in which the participating school was situated. These data are shown in Table 2, page 53.

Data from this table indicate that of the 25 schools selected to participate in the study, eight were classified as rural schools and the remaining 17 schools were categorized as urban schools. No schools were placed in the suburban classification.

Student Enrolment

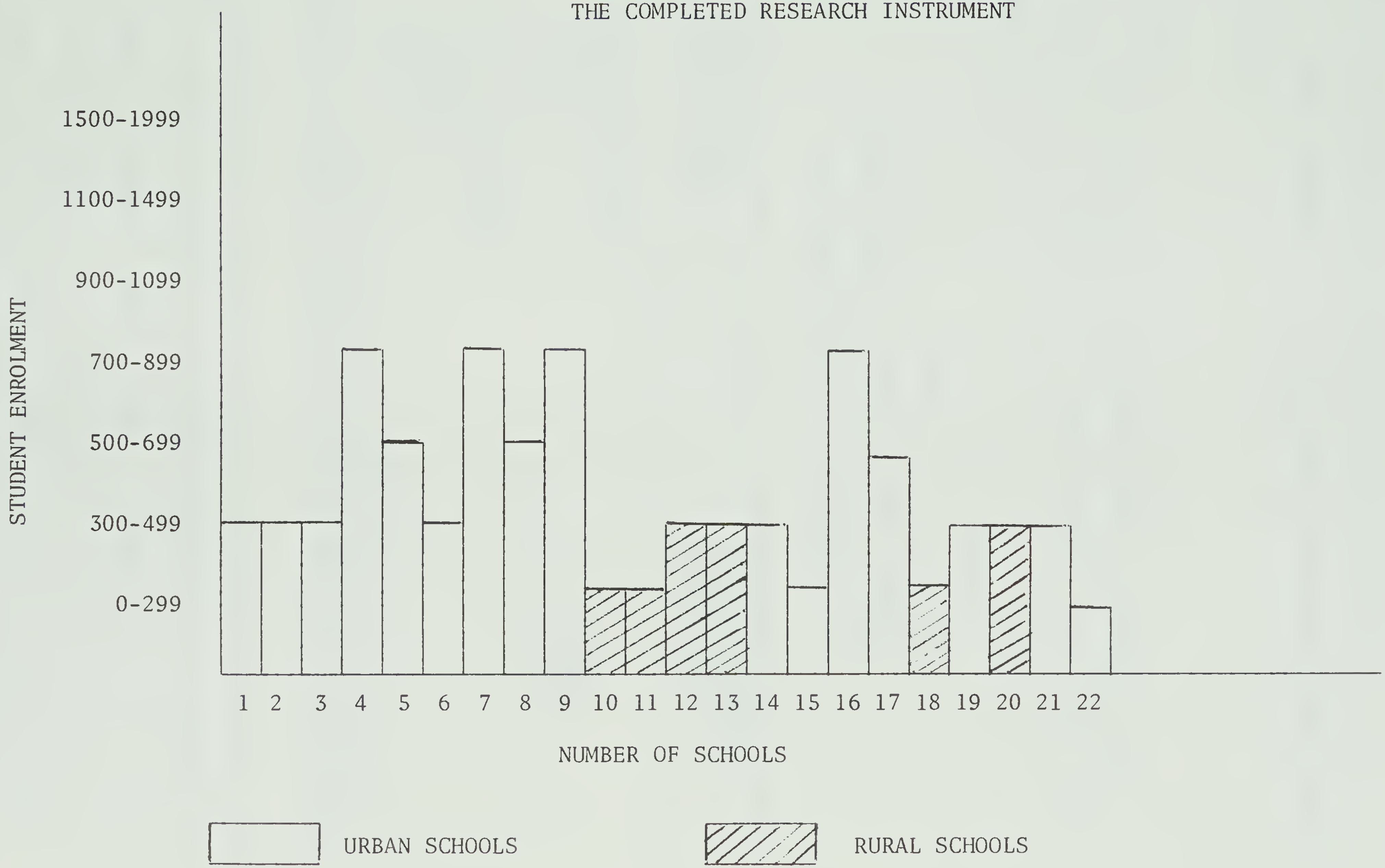
The third question on the School Profile Information Sheet asked the teachers involved in the study to identify student enrolment of their schools using a seven-point scale that ranged from 0-1999 students.

In Figure 2, these data indicate that of the 22 participating schools, 16 were urban schools and the remaining six were categorized as being rural schools. These data also show that of the urban schools, two had student enrolments of not less than 300 pupils but not greater than 499 pupils. Further, three of the urban schools had student enrolments of not less than 500 pupils but not greater than 699 pupils; whereas, four urban schools had a student enrolment of between 700 and 899 pupils.

The bars in this graph also show that of the six rural schools that were involved in the study, three had student enrolments of no greater than 299 pupils. Three rural schools had student enrolments of

FIGURE 2

STUDENT ENROLMENT IN SCHOOLS (URBAN AND RURAL) THAT RETURNED THE COMPLETED RESEARCH INSTRUMENT



not less than 300 pupils and no greater than 499 pupils.

No school involved in the study had a student enrolment of more than 900 pupils.

Grades Taught

The fourth question on the School Profile Information Sheet asked the teachers to identify the grade(s) taught in the school where they were employed.

TABLE 4

GRADES TAUGHT BY INDUSTRIAL ARTS TEACHERS WHO PARTICIPATED IN THE RESEARCH

GRADES TAUGHT - INDUSTRIAL ARTS	NUMBER OF SCHOOLS IN THE STUDY
JUNIOR HIGH SCHOOL	
GRADE 7	16
GRADE 8	21[a]
GRADE 9	21[a]
SENIOR HIGH SCHOOL	
GRADE 10	4
GRADE 11	4
GRADE 12	4

[a] Three schools in this category were senior high schools offering a programme of studies in industrial arts for junior high school grades

Data in Table 4 show that of the 22 responding schools that completed the research instrument, 16 offered industrial arts programmes of study to grade 7 students in their schools. Twenty-one schools stated that they taught industrial arts programmes of study to students in grades 8 and 9. Of the 21 schools, three of these were junior-senior high schools that were included in the senior high school category.

Other data in this table indicate that four of the schools offered programmes of study in industrial arts to grade 10, 11 and 12 students in their schools.

Industrial Arts Profile

Materials Areas

The first question in the Industrial Arts Profile asked the participating teachers to identify those materials areas that were offered in the industrial arts programme of study in their specific school.

Data in Table 5 show a distribution of the range of the five materials areas taught by teachers involved in the research.

TABLE 5

MATERIALS AREAS TAUGHT IN PARTICIPATING SCHOOLS

TYPE OF COMMUNITY AND SCHOOL	MATERIALS AREAS TAUGHT				
	EARTHS	MATERIALS TESTING	METALS	PLASTICS	WOODS
RURAL					
JUNIOR HIGH	2	0	2	1	2
SENIOR HIGH	4	0	4	4	4
URBAN					
JUNIOR HIGH	5	1	15	12	15
SENIOR HIGH	1	0	1	1	1
TOTAL	12	1	22	18	22

In analyzing data from this table the reader should keep in mind the organizational pattern for industrial arts multiple activity laboratories in the Province of Alberta which was discussed in Chapter II of this report.

Data in Table 5 will total more than 22 because teachers involved in the study taught in more than one materials area which is common practice in a multiple activity laboratory.

Significant data from this table show that the most prevalent materials areas taught by participating teachers both in rural and urban schools were metals 22, woods 22, plastics 15, and earths 12. Further analysis of data from the table show that industrial arts teachers from urban junior high schools concentrated their teaching in the metals, plastics and woods areas of their laboratories, while their colleagues who teach at the senior high school level spread their time teaching in each of the materials areas.

Data from this table also show that the industrial arts teachers in rural senior high schools taught all materials areas with the exception of materials testing which was not taught in any rural senior high school. In rural junior high schools materials testing was not taught; however, the industrial arts teacher in these schools taught earths, metals, plastics, and woods.

Technology Areas

The second question in the Industrial Arts Profile asked the participating teachers to identify those technology areas that were offered in the industrial arts programme of study.

Data in Table 6 show a distribution of the range of the six

technology areas taught by teachers participating in the study.

TABLE 6

TECHNOLOGY AREAS TAUGHT IN

PARTICIPATING SCHOOLS

TYPE OF COMMUNITY AND SCHOOL	TECHNOLOGY AREAS					
	COMPUTERS	ELECTRICITY	ELECTRONICS	GRAPHIC COM-MUNICATIONS	POWER	VISUAL COM-MUNICATIONS
RURAL						
JUNIOR HIGH	0	2	2	2	2	1
SENIOR HIGH	0	3	2	3	3	3
URBAN						
JUNIOR HIGH	1	14	6	11	11	6
SENIOR HIGH	1	1	1	1	1	1
TOTAL	2	20	11	17	17	11

As with the preceding table, the reader is asked to keep in mind the organizational pattern for industrial arts multiple activity laboratories in the Province of Alberta.

Data in Table 6 will total more than 22 because teachers involved in the study taught in more than one technology area.

Significant data from the table show that the most prevalent technology areas taught by participating teachers were electricity 20, graphic communications 17 and power 17. Further analysis of the data from the table show that industrial arts teachers from urban junior high schools concentrated their teaching in the electricity, graphic communications and power areas. Their colleagues who teach at the senior high

school level spread their time teaching in each of the technology areas.

Data from this table also show that the industrial arts teachers in rural senior high schools taught all areas with the exception of computers, which was not taught in any rural senior high school. In rural junior high schools computers was not taught, though the teachers of industrial arts taught electricity, electronics, graphic communications, power, and visual communications.

Industrial Arts Student Enrolment

Data presented in Figure 3 summarize the number of students enrolled in industrial arts programmes of study for the participating schools.

The data in this graph is self-explanatory.

It is evident from the data in Table 7, dealing with the total number of students involved in industrial arts programmes of study, that in rural areas more students are enrolled in industrial arts at the senior high school level (570 students) than are enrolled in the programmed at the junior high school level (194 students).

The reverse is true for urban industrial arts programmes. Senior high school industrial arts programmes show a lower enrolment than junior high school enrolments. Enrolment for the industrial arts programme at the senior high school level was 325 students, whereas the enrolment at the junior high school level was about eight times as many - 2698 students.

TABLE 7

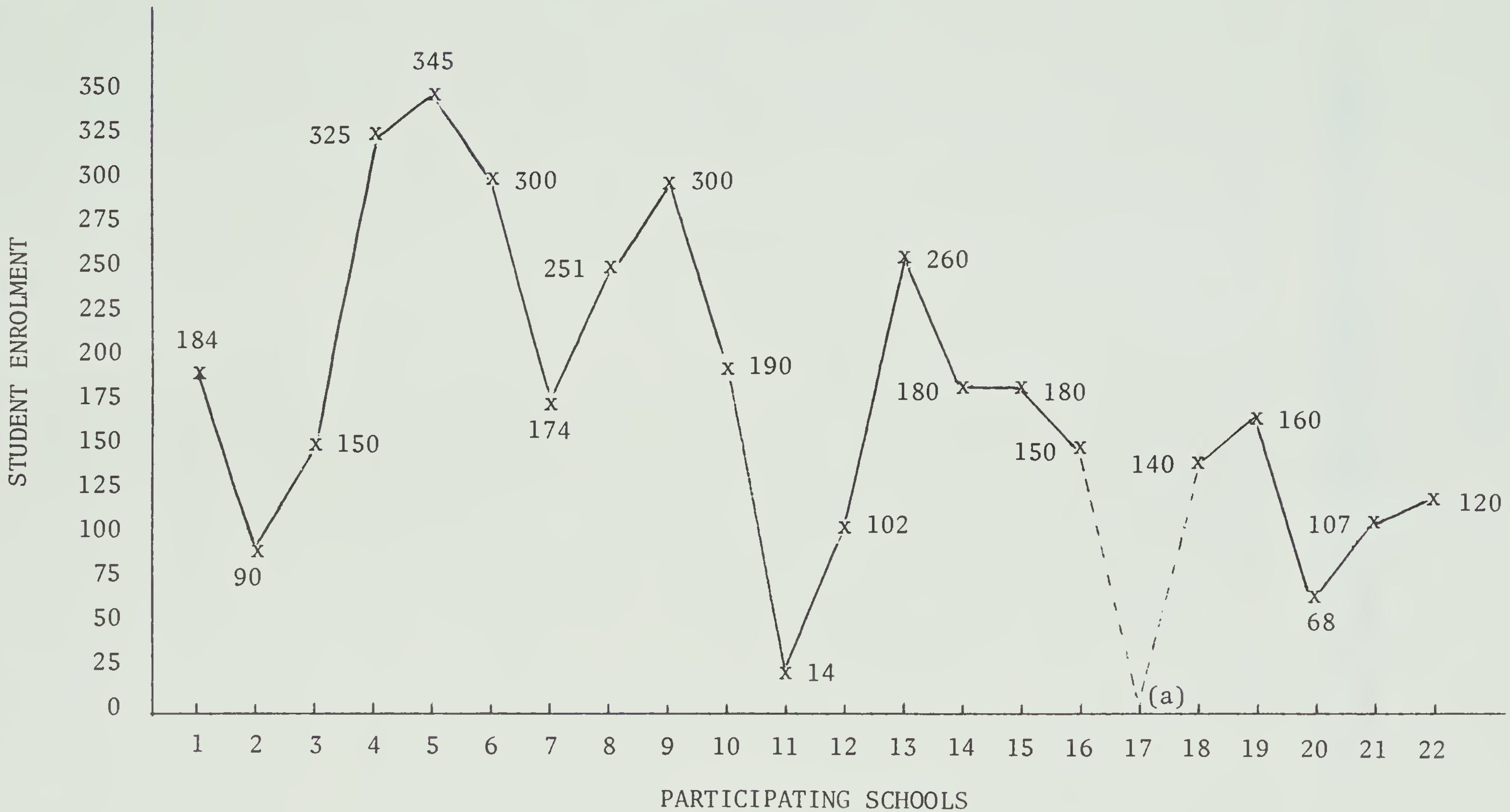
TYPE OF COMMUNITY AND NUMBER OF STUDENTS IN JUNIOR HIGH SCHOOLS AND SENIOR HIGH SCHOOLS TAKING INDUSTRIAL ARTS

TYPE OF COMMUNITY	NUMBER OF STUDENTS ENROLLED IN INDUSTRIAL ARTS		TOTAL NUMBER OF STUDENTS ENROLLED FOR EACH CATEGORY
	JUNIOR HIGH	SENIOR HIGH	
RURAL	(2) 194	(4) 570	(6) 764
URBAN	(14) 2698[a]	(1) 325	(15) 3023
TOTAL	(16) 2892	(5) 895	(21) 3787

[a]One urban junior high school did not furnish this data
The number in () indicates the number of schools making up the totals.

FIGURE 3

NUMBER OF STUDENTS ENROLLED IN INDUSTRIAL ARTS PROGRAMMES OF STUDY OF PARTICIPATING SCHOOLS



[a] The participant from this school did not provide the information requested

References

Ferguson, G. A. Statistical Analysis in Psychology and Education. New York: McGraw-Hill Book Company, 1971.

CHAPTER IV

ANALYSIS OF DATA

Chapter III of this report presented a detailed description of the methodology used in conducting the research. Discussion in that chapter included the design of the research instrument; the pilot study used to pretest the instrument that was used with the major investigation; the population and the sample selection, and the administration of the instrument in participating schools to collect data for analysis.

This chapter will analyze this received data and present these data in tabular form, whilst at the same time presenting costs directed at either replacement or modification of hand tools and machine tools that were available during the time frame when the study was conducted, namely 1974-75.

Percentage of Returns

An analysis of data from Table 8 show that a total of 25 instruments were mailed to 25 schools selected to participate in the study. Of the 25 instruments posted, 22 were returned. This represented a return of 88 percent.

Data from Table 8 also indicate that six out of eight rural schools completed and returned the research instrument, thereby representing a 75 percent return for rural schools.

Seventeen research instruments were mailed to industrial arts teachers in selected urban schools. Of these 17 instruments, 16 were

TABLE 8

PERCENTAGE OF RETURNS FOR

STUDY PARTICIPANTS

TYPE OF COMMUNITY	NUMBER OF INSTRUMENTS MAILED			NUMBER OF INSTRUMENTS RETURNED			PERCENTAGE OF RETURNS
	JHS	SHS	TOTAL	JHS	SHS	TOTAL	
RURAL	2	6	8	2	4	6	75
URBAN	16	1	17	15	1	16	94
TOTAL	18	7	25	17	5	22	88

returned for analysis, representing a 94 percent rate of return for teachers in urban schools.

Hand Tool and Machine Tool Costs

The prices listed in the tables that appear in this chapter were secured from catalogues of vendors furnishing supplies and equipment to industrial arts laboratories. The prices are accurate for the school year 1974-75, the time when this study was conducted and completed.

HAND TOOLS

Metalwork

Data from Table 9, "Number on Hand, Cost Per Unit and Total Replacement Costs for Metalwork Hand Tools in Participating Schools" present an equipment census for the hand tools for metalwork, found in the industrial arts metals areas of the schools involved in the study. These data show that there were 30 - 6" steel rules to be found in

TABLE 9

NUMBER ON HAND, COST PER UNIT AND TOTAL REPLACEMENT COSTS

FOR METALWORK HAND TOOLS IN PARTICIPATING SCHOOLS

HAND TOOLS	NUMBER ON HAND	COST PER UNIT	TOTAL REPLACEMENT COST
Rules - 6" Steel	30	$ 2.35	$ 70.50
Rules - 12" Steel	124	4.30	533.20
Tape - 10'	21	2.49	52.29
Micrometer - 1" (B & S #599-4)	20	22.85	457.00
Squares - Tri 6" (Stanley #12TS)	73	2.79	203.67
Square - Combination 12" (Stanley #H1222 1/2)	55	5.99	329.45
Square - Combination Set - 12" steel rule, centre head, protractor head (Miller Falls 1274)	19	37.98	721.62
Tap and Die Set - Machine, Screw up to 5/8", NC-NF (Butterfield)	23	59.98	1,379.54
Wrenches - Set - Allan Long Stem 5/64"-3/8"	19	2.98	56.62
Wrenches - Set - Combination 1/4"-7/8" in 1/16"	13	21.50	279.50
Other:			
Drill Gauge	1	9.85	9.85
Wire Gauge	1	6.00	6.00

the 22 responding schools (see data in Table 3, page 55). At the 1974-75 prices, to replace one of these 6" rules with a metrically graduated 150 mm rule, the cost would be $2.35. The total replacement cost for 30 - 150 mm rules would be $70.50 if purchased during the 1974-75 fiscal year.

There were 124 - 12" steel rules identified in the study. Each of these rules, to be replaced at 1974-75 prices would cost $4.30. To replace these rules totally would involve an expenditure of $533.20.

The remaining data in this table can be interpreted in a similar manner.

So that participants in the study could identify other hand tools that were not listed in the instrument, the category of "Other" was included in the instrument. In these designated spaces the industrial arts teacher involved in the study could write-in those items, if any.

Within the metalworking area the following items were identified in the category of "Other": (1) drill gauge and (1) wire gauge. At 1974-75 prices, to replace a drill gauge, the cost would be $9.85. For the wire gauge to be replaced a cost of $6.00 per unit would be incurred.

Plastics

Data in Table 10, "Number on Hand, Cost Per Unit and Total Replacement Costs for Plastics Hand Tools in Participating Schools", present an equipment census for the hand tools for plastics, found in the industrial arts plastics areas of the schools involved in the study. These data show that there were 14 square - combination set - 12", including the blade, centre head, 90°-45° head and protractor to be found in the 22 responding schools (see data in Table 3, page 55). At

TABLE 10

NUMBER ON HAND, COST PER UNIT AND TOTAL REPLACEMENT COSTS

FOR PLASTICS HAND TOOLS IN PARTICIPATING SCHOOLS

HAND TOOLS	NUMBER ON HAND	COST PER UNIT	TOTAL REPLACEMENT COST
Rule - 12" Steel (Rabone)	22	$ 4.30	$ 94.60
Rule - 36" Steel	2	10.90	21.80
Tape - 10'	6	2.49	14.94
Square - Combination Set 12", 4 pcs.	14	37.98	531.72
Square - Tri 6" (Stanley 12TS)	20	2.79	55.80
Scales - spring 1-25 lbs. lab type (#6561 Hansen)	2	7.50	15.00
Drill and Countersink 1/8" (Marshall Wells #13-8721)	7	1.65	11.55
Drill and Countersink 3/16" (Marshall Wells #13-8722)	6	2.55	15.30
Saw Blade - to fit circular or radial arm saw	34	10.29	349.86

1974-75 prices, to replace all of these combination square sets with a metrically graduated set (300 mm blade), the cost would be $37.98. The total replacement costs for the 14 squares on hand in participating schools would be $531.72 if purchased during the 1974-75 fiscal year.

There were 20 squares - try 6" identified in the study. Each of these try-squares to be replaced at 1974-75 prices would cost $2.79. To replace these try-squares totally would involve an expenditure of $55.80.

Woodwork

Data in Table 11, "Number on Hand, Cost Per Unit and Total Replacement Costs for Woodwork Hand Tools in Participating Schools", present an equipment census for the hand tools for woodwork, found in the industrial arts woodworking areas of the schools involved in the study. These data show that there were 18 tapes - steel 8' to be found in the 22 responding schools (see data in Table 3, page 55). At the 1974-75 prices, to replace an 8' steel tape with a suitable 3 metre tape, it would cost $2.99. The total replacement cost for the 18 - 8' steel tapes on hand with 3 metre tapes would be $53.82, if purchased during the 1974-75 fiscal year.

There were 12 circle cutters 1"-5" identified in the study. Each of these circle cutters to be replaced by a suitable equivalent at 1974-75 prices would cost $5.37. To replace these circle cutters totally with metrically graduated circle cutters would require an expenditure of $64.44.

The remaining data in this table can be interpreted in a similar manner.

TABLE 11

NUMBER ON HAND, COST PER UNIT AND TOTAL REPLACEMENT COSTS

FOR WOODWORK HAND TOOLS IN PARTICIPATING SCHOOLS

HAND TOOLS	NUMBER ON HAND	COST PER UNIT	TOTAL REPLACEMENT COST
Rules - 12" Steel (Rabone #25)	67	$ 4.30	$ 288.10
Tape - Steel 8' (Stanley #120W)	18	2.99	53.82
Squares - Tri 6" (Stanley #12)	68	2.79	189.72
Square - Sliding T 8" (Stanley #25TB)	21	2.49	52.29
Square - Combination 12" (Stanley #22)	45	5.99	269.55
Square - Frame 16 x 24 (Stanley #R100)	39	6.49	253.11
Drills - Set - HSS steel by 1/64-1/2" c/w index	28	21.56	603.68
Countersink 1/4" shank 5/8" dia. 82° (Stanley #137)	20	1.70	34.00
Bit - expansive (Walter Woods 3A587-22)	27	4.60	124.20
Bits - Set - Forstner 3/8", 1/2", 5/8", 3/4", 1"	14	29.93	419.02
Circle Cutter 1"-5" (#418 Stanley)	12	5.37	64.44
Plug Cutter - Set - 3/8", 1/2", 5/8"	7	4.95	34.65
Sanding Drum - 1" dia.) Expandable - no need for change	8	5.05	40.40
Sanding Drum - 3" dia.)	13	5.00	65.00

TABLE 11 (Continued)

HAND TOOLS	NUMBER ON HAND	COST PER UNIT	TOTAL REPLACEMENT COST
Wing - Set - 13 pcs., 5/16"-1" in 1/16" (Irwin)	10	10.95	109.50
Wrenches - Set - Combination 3/8, 1/16, 1/2, 9/16, 5/8, 11/16, 3/4, 7/8	9	23.38	210.42
Other:			
Gauge - Marking	1	4.06	4.06
Square - Tri 8"	6	3.40	20.40
Straight Edge 3'	1	10.90	10.90
Tape - 6'	1	2.39	2.39

In the woodworking area the following items were identified in the category of "Other": (1) marking guage; (6) try-squares 8"; (1) straight edge 3 ft.; and (1) tape 6 ft. At 1974-75 prices, to replace a marking gauge the cost would be $4.06. For the try-squares to be replaced at a unit cost of $3.40, a total replacement cost of $20.40 would be realized. The replacement cost for a straight edge 3 ft. would be $10.98, whereas a 6 ft. tape would cost $2.39 to replace.

Photography

Data from Table 12, "Number on Hand, Cost Per Unit and Total Replacement Costs for Photography Hand Tools in Participating Schools", present an equipment census for the hand tools for photography, found in the industrial arts photography areas of the schools involved in the study. These data show that there were 38 thermometers - darkroom to be found in the 22 responding schools (see data in Table 3, page 55). At 1974-75 prices to replace one of these thermometers with one of similar kind graduated in degrees Celsius, it would cost $15.00. The total replacement cost for the 38 thermometers on hand would be $570.00, if purchased during the 1974-75 fiscal year.

There were 39 graduated flasks identified in the study. Each of these flasks if replaced at 1974-75 prices would cost $4.00. To replace the 39 flasks with flasks in ml units would involve an expenditure of $156.00.

Graphic Communications

Data in Table 13, "Number on Hand, Cost Per Unit and Total Replacement Cost for Graphic Communications Hand Tools in Participating

TABLE 12

NUMBER ON HAND, COST PER UNIT AND TOTAL REPLACEMENT COSTS

FOR PHOTOGRAPHY HAND TOOLS IN PARTICIPATING SCHOOLS

HAND TOOLS	NUMBER ON HAND	COST PER UNIT	TOTAL REPLACEMENT COST
Thermometer - Darkroom, tank and tray, stainless steel	38	$ 15.00	$ 570.00
Graduate - 8 oz., 16 oz., 32 oz., darkroom (Kodak)	39	4.00	156.00

TABLE 13

NUMBER ON HAND, COST PER UNIT AND TOTAL REPLACMENT COSTS

FOR GRAPHIC COMMUNICATIONS IN PARTICIPATING SCHOOLS

HAND TOOLS	NUMBER ON HAND	COST PER UNIT	TOTAL REPLACEMENT COST
Scales - Architect's 12" plastic (K & E #18881)	181	$ 5.05	$ 914.05
Scales - Engineer's 12" plastic (Normand Wade DS49-380)	21	5.05	106.05
Parallel Rule (30" x 42" table)(Mayline)	3	17.45	52.35
Drafter - Track c/w 1/8"-1/4" and 1/2"-1" clear plastic scales to fit 30" x 42" table (Mutoh)	0	0.00	0.00
T-Square - 24"	253	3.30	834.90
Drafting Machine 18" c/w 1/8"-1/4" and 1/2"-1" clear plastic scales (Paragon Junior)	16	8.10	129.60
Table - Drafting (Norman Wade DF1055520) 30" x 42" c/w covering	51	72.00	3,672.00
Table - Drafting (Nikette Model 312-2031) 30" x 42" c/w covering	30	72.00	2,160.00

Schools", present an equipment census for the hand tools for plastics, found in the industrial arts graphic communications areas of the schools involved in the study. These data show that there were 181 scales - architect's 12" plastic to be found in the 22 responding schools (see data in Table 3, page 55). At 1974-75 prices, to replace one of these architect's scales with one graduated in metric units, the cost would be $5.05. The total replacement costs for the 181 architect's scales for participating schools would be $914.05, if purchased during the 1974-75 fiscal year.

There were 21 scales engineer's 12" plastic identified in the study. Each engineer's scale, if replaced at 1974-75 prices would cost $5.05. To replace 21 engineer's scales identified in the study would involve an expenditure of $106.05.

The remaining data in this table, like other tables in this chapter, can be interpreted in a similar manner.

Graphic Arts

Data from Table 14, "Number on Hand, Cost Per Unit and Total Replacement Costs for Graphic Arts Hand Tools in Participating Schools", present an equipment census for the hand tools for graphic arts, found in the industrial arts graphic arts areas of the schools involved in the study. These data show that there was 1 typewriter - 15" carriage to be found in the 22 responding schools (see data in Table 3, page 55). At 1974-75 prices, to replace the elements with ones containing metric symbols, the cost would be $10.00 per element. The total replacement cost for the four more common elements required for the typewriter would be $40.00, if purchased during the fiscal year 1974-75.

TABLE 14

NUMBER ON HAND, COST PER UNIT AND TOTAL REPLACEMENT COSTS

FOR GRAPHIC ART HAND TOOLS IN PARTICIPATING SCHOOLS

HAND TOOLS	NUMBER ON HAND	COST PER UNIT	TOTAL REPLACEMENT COST
Typewriter - c/w 15" carriage, carbon ribbon, 4 elements, 12 pitch, #005, #090, #053, #085 (IBM Selectric 713)	1	$ 10.00	$ 40.00
Typewriter, c/w 4 elements, 12 pitch, #005, #090, #053, #085 (IBM Selectric 713)	3	10.00	120.00
Cutter - power paper 15" (Triumph #15E)	4	25.95	103.80
Duplicator - Offset, single lever control (A.B. Dick 350, AM 1250, Gestetner 201)	9	N.M.[a]	
Punching and Binding Unit (GB Super Combo)	1	27.95	27.95

[a] N.M. = No Modification

There was 1 punching and binding unit identified in the study. For this punching and binding unit to be replaced at 1974-75 prices a cost of $27.95 would be incurred.

The remaining data in this table can be interpreted in a similar manner with the exception of the offset duplicator. The A. B. Dick representative stated that no change would be required for his company's machines due to their being already adapted for metric operation. Other companies manufacturing offset duplicators were unable to furnish the researcher with information pertaining to conversion at this time.

Power

Data from Table 15, "Number on Hand, Cost Per Unit and Total Replacement Costs for Power Hand Tools in Participating Schools", present an equipment census for the hand tools for power, found in the industrial arts power areas of the schools involved in the study. These data show that there were 11 micrometers 0"-4" to be found in the 22 responding schools (see data in Table 3, page 55). At 1974-75 prices, to replace one of these micrometers graduated in millimetres (mm), the cost would be $27.29. The total replacement cost for the 11 micrometers on hand would be $300.19 if purchased during the 1974-75 fiscal year.

There were 15 gauges - compression - 0-300 PSI identified in the study. Each of these compression gauges to be replaced at 1974-75 prices would cost $19.37. To replace these compression gauges totally would involve an expenditure of $290.55.

With the exception of the engine analyser and the engine analysis system equipment that will not be affected by conversion, the remaining data in this table can be interpreted in a similar manner.

TABLE 15

NUMBER ON HAND, COST PER UNIT AND TOTAL REPLACEMENT COSTS

FOR POWER HAND TOOLS IN PARTICIPATING SCHOOLS

HAND TOOLS	NUMBER ON HAND	COST PER UNIT	TOTAL REPLACEMENT COST
Rule - 12" Steel in 64th (Rabone #25)	13	$ 4.30	$ 55.90
Gauge - vacuum and pressure - 0-30"	9	6.50	58.50
Micrometer - 0-4" (B & S 59940-3)	11	27.29	300.19
Tube Cutter - 1/8"-1 1/8"	9	6.40	57.60
Gauge - Compression - 0-300 PSI (Allen 17-02)	15	19.37	290.55
Gauge - set of Feeler - 25 3" blades, 10015-040 (Proto Book)	20	4.95	99.00
Gauge - Spark Plug wire type c/w electrode bender (Gray FG-7)	12	0.85	10.20
Engine Analyser (Allen 1094) c/w training materials	5	N.M.[a]	
Tachometer (#757 Stewart Warner)	13	N.M.[a]	
Engine Analysis System (Go-Power DA) for multi-cylinder engines	4		
Compression Tester c/w remote start (Allen 50-217)	4	7.50	30.00
Wrench - Set - combination 1/4"-7/8" in 16th (Durochrome)	15	22.98	344.70
Wrench - socket, spark plug 1/4" drive, 13/16" c/w special rubber insert	11	3.49	38.39

TABLE 15 (Continued)

HAND TOOLS	NUMBER ON HAND	COST PER UNIT	TOTAL REPLACEMENT COST
Wrenches - Set - Socket - 16 pcs., 6 pt., 1/4" drive, 3/16"-1/2" c/w ratches, handles, extensions	13	19.98	259.74
Wrench - Torque 1/4" drive, 0-300 inch lbs. (Proto Torquemaster, Durochrome, Gray)	8	17.98	143.84
Wrenches - Set - Sockets, 16 pcs., 12 pt., 3/8" drive, 3/8"-7/8", 5 extension, 17" speed handle, flex handle, universal joint, reversible ratchet	13	16.98	220.74
Wrenches - Set - Tappet - 3/8 x 7/16, 1/2 x 9/16	2	8.98	17.96
Small engine tool kit #291661 (Briggs & Stratton)	7	9.98	69.86
Punches - Set - Pin, 1/8", 3/16", 11/64"	19	19.98	379.62
Wrench - Torque - 3/8" drive 10-150 lbs. (Proto Torquemaster or Durochrome)	12	17.98	215.76
Wrenches - Set - ignition	7	21.50	150.50
Screwdrivers - Set - sq. shank, 1/8", 3/16", 5/16", 3/8"	18	9.98	179.64
Gasoline Can - 1 gallon safety type (Protectoseal)	28	16.20	453.60
Flaring Set - 3/16"-5/8"	10	5.32	53.20
Scope - ignition simulator (Allen 30-34AC)	2	N.M.[a]	

[a]N.M. = No Modification

It will be recalled that the research instrument was divided into two categories. One category dealt with hand tools for each materials or technology area in industrial arts. The second category dealt with machine tools used to work a material or used with a basic technology.

The reader in reviewing the tables of this section of the report will note that some of the prices for the machine tools identified are missing. At the time when the study was completed the prices for modifying these pieces of equipment were not available to the researcher from either the manufacture or their representative.

MACHINE TOOLS

Metalwork

Data in Table 16, "Number on Hand, Modification Cost Per Unit, and Total Modification Costs for Metalwork Machine Tools in Participating Schools", present a census of metalworking machine tools found in the metals area of the industrial arts laboratories involved in the study. According to data in this table there were 20 7" bench grinders found in the 22 schools involved in the study (see data in Table 3, page 55). Prices for the modification kit for this machine, namely the arbor, were not available from the sources contacted at the time of the study.

In the 22 schools that participated in the study there were 21 7"-10" swing engine lathes located in the industrial arts laboratories. For each of these lathes to be modified for metric usage, only an estimation of the conversion costs was obtainable from the manufacturers or from the suppliers. This estimate proved to be within the

TABLE 16

NUMBER ON HAND, MODIFICATION COST PER UNIT, AND TOTAL MODIFICATION COSTS

FOR METALWORK MACHINE TOOLS IN PARTICIPATING SCHOOLS

MACHINE TOOLS	NUMBER ON HAND	MODIFICATION COST PER UNIT	TOTAL MODIFICATION COST
Grinder - 7" Bench Type c/w lighted safety eyeshield, wheel guards, tool rests, water pot, 1/2 HP, 3450 RPM, c/w coarse grinding wheels (Delta)	20	N.C.A.[(a)]	
Lathe - engine (Myford M-7, South Bend CL-6702), Boxford), 7-10" swing, 22" between centres, all guards, quick change gear box, 1/2 HP-110 V-1/60 motor complete, c/w drum switch, taper attachment, thread dial indicator, revolving head knurling tool, fitted 5" 3-jaw universal chuck, fitted 6" 4-jaw independent chuck, Jacob's drill chuck, 1/2" capacity, 6-7" face-plate, tool steel centres, left-hand cutting-off tool holder, 6 ground cutter bits, 6 unground cutter bits, boring tool holder, tray, revolving centre for tailstock, safe work light, lathe cover	21	$300-400	$6300-8400
Milling Machine - Horizontal (Tom Senior), 7 1/2" swing dividing head, 1" raising blocks and chuck, 8" diameter rotary S Type table, 4" vise, cutter guard, collett chuck, 110/220/1/60 1 HP motor	3	$300-400	$ 900-1200

TABLE 16 (Continued)

MACHINE TOOLS	NUMBER ON HAND	MODIFICATION COST PER UNIT	TOTAL MODIFICATION COST
Lathe - Engine metal bench Model 10" (South Bend, Boxford), 110/1/60 motor, drum switch, thread dial indicator, taper attachment, knurling tool, threading tool, 5" 3-jaw universal chuck, Jacob's 12" chuck and taper shank arbor, straight-right-left hand turning tool holder, RH cutting-off tool holder, 6 ground cutter bits, 12 unground cutter bits, boring tool holder, independent 4-jaw chuck with reversible jaws	21	$300-400	$6300-8400
Milling Machine - Horizontal (Hamilton XM-20 Burke), c/w installed slow speed attachment, motor, manual, switch, belt guard, cut-off switch, over-arm assembly, milling arbor, drawbar, milling vise, slitting saw, 1/8" side mill cutter, 3/16" and vertical milling machine (Hamilton), c/w motor, manual, switch, drill chuck 1/4", end mill adaptor shell mill holder, draw-bar, milling vise, end mill 3/8", shell end mill 1 1/4"	2	$300-400	$ 600-800
Milling Machine accessory package - plain milling cutter, 2 1/2 x 1/4, 2 1/2 x 3/16, 2 1/2 x 3/8, 2 1/2 x 6/16, side milling cutter 3 x 1/4, slitting cutter 4 x 1/16, double angle cutter 60° 2 3/4 x 1/2, convex milling cutter 2 1/2 x 1/2, vertical milling cutter 1/8, 1/4, 3/8, 1/2	2	$ 54.15	$ 108.30

TABLE 16 (Continued)

MACHINE TOOLS	NUMBER ON HAND	MODIFICATION COST PER UNIT	TOTAL MODIFICATION COST
Welding - gas (Purox 40L41W-275A) medium duty welding and cutting outfit c/w W275 torch, CW275 cutting attachment, #6, #12, #30 welding heads, #5 cutting nozzle, single stage oxygen and acetylene regulators, 25"-3/16 twin hose, 3 pr. #21-N goggles, friction lighter, wrench, tip cleaner, oxygen and acetylene check valves and complete instructions	4	$ 120.00	$ 480.00

[a] N.C.A. = No Costs Available

$300-$400 price range per machine. Therefore the total modification costs for the 21 machines on hand would range from a low of $6,300 to a high of $8,400.

The remaining data in this table, with the exception of the milling machine accessory package and gas welding outfit, may be interpreted in this manner. The modification costs for these pieces of equipment have been fixed by the manufacturers and are found in this table.

Plastics

Data from Table 17, "Number on Hand, Modification Cost Per Unit and Total Modification Costs for Plastic Machine Tools in Participating Schools", present a census of plastics machine tools found in the plastics area of the industrial arts laboratories involved in the study. According to these data there were 10 air compressors, portable (100 lbs.) to be found in the 22 schools involved in the study (see data in Table 3, page 55). For each of these air compressors to be modified for metric usage - replacement of pressure gauges - a cost of $26.95 per unit would be incurred. The total modification costs for the 10 air compressors on hand would be $269.50, if completed during the 1974-75 fiscal year.

In the 22 schools that participated in the study, there were 14 strip heaters located in the laboratories. Prices for the modification kit for each strip heater - the replacement of the thermostat - were not available from the sources contacted at the time of the study.

The remaining data in this table may be interpreted in this manner, as the modification costs for these pieces of equipment have not been fixed by the manufacturers.

TABLE 17

NUMBER ON HAND, MODIFICATION COST PER UNIT, AND TOTAL MODIFICATION COSTS

FOR PLASTICS MACHINE TOOLS IN PARTICIPATING SCHOOLS

MACHINE TOOLS	NUMBER ON HAND	MODIFICATION COST PER UNIT	TOTAL MODIFICATION COST
Press - Laminating (Wabash #12-10-2TWC) c/w thermoset kit, laminating kit, rubber stamp kit, compression molding kit	5	N.C.A.[a]	
Rotational Molder - (Vega #14), thermostat control, timer, pilot light c/w molds - 3 animals, shakers ball, cube, wheel, freezer can	7	N.C.A.[a]	
Air Compressor - portable - quick disconnect fittings, 2 - 20 gal. pressure 100 lbs. (Micro-Lyn #46)	10	$ 26.95	$ 269.50
Strip Heater - 500 watt element, pilot light, 6 feet grounded cord, thermostat control	14	N.C.A.[a]	
Vacuum and blow forming unit (Model CT1214 or TP-1612), 110 V motor, self-contained vacuum pump, air hose and quick connect couplings c/w molds, bowl, tray, latern	13	N.C.A.[a]	

[a] N.C.A. = No Costs Available

Woodwork

Data from Table 18, "Number on Hand, Modification Cost Per Unit, and Total Modification Costs for Woodwork Machine Tools in Participating Schools", present a census of woodwork machine tools found in the woodwork area of the industrial arts laboratories involved in the study. According to the data in this table there were 8 1/3 HP grinders to be found in the 22 schools involved in the study (see data in Table 3, page 55). Prices for the modification kit for this machine, namely the arbor, were not available from the manufacturers and suppliers contacted at the time of the study.

The remaining data in this table may be interpreted in this manner.

Ceramics

Data from Table 19, "Number on Hand, Modification Cost Per Unit, and Total Modification Costs for Ceramics Machine Tools in Participating Schools", present a census of ceramic machine tools found in the ceramics area of the industrial arts laboratories involved in the study.

According to the data in this table, there were 11 kilns to be found in the 22 schools involved in the study (see data in Table 3, page 55). Prices for the modification kit for this machine, namely a thermostat and temperature gauge, were not available from the manufacturers and suppliers contacted at the time of the study.

The remaining data in this table may be interpreted in this manner.

TABLE 18

NUMBER ON HAND, COST PER UNIT AND TOTAL REPLACEMENT COSTS

FOR WOODWORK MACHINE TOOLS IN PARTICIPATING SCHOOLS

MACHINE TOOLS	NUMBER ON HAND	COST PER UNIT	TOTAL REPLACEMENT COST
Grinder (Stanley #697) Edge Tool c/w #600 "Flud-lite" eye-shields, 2 grinding wheels, 1 coarse MS373, 1 extra fine MS476, heavy duty switch, 1/3 HP motor, split phase, 110V with grounded attachment cord, edge tool grinding attachment	8	N.C.A.[(a)]	
Saw - Radial Arm 10", 2 HP 110/220/1/60 motor, automatic brake, enclosed stand, guards, 10" plywood blade, 10" combination blade, dado set and guard (Craftsman)	4	N.C.A.[(a)]	
Saw - Circular 8" tilting arbor (General or Delta) c/w jet-lock fence, combination blade, mitre gauge, front graduated bar, rear guide bar, table inset, 1 1/2 HP electric motor, 120/208 V/1/60 single phase 3450 RPM, magnetic switch, dado set and insert, extension wings, rip blade, plywood blade, Brett guard	11	N.C.A.[(a)]	
Saw - Circular 10" tilting arbor (General or Delta Unisaw) c/w jet-lock fence, combination blade, mitre gague, front graduated bar, rear guide bar, dado head set, and table insert, cast iron side wings, 10" rip blade, 10" plywood blade, single phase 208 V-3450 RPM, 1 1/2 HP, magnetic switch Brett guard, ready to operate	10	N.C.A.[(a)]	

TABLE 18 (Continued)

MACHINE TOOLS	NUMBER ON HAND	COST PER UNIT	TOTAL REPLACEMENT COST
Wood Welder 3/4 118 (Workrite Model 1500)	0	N.C.A.[a]	

[a] N.C.A. = No Costs Available

TABLE 19

NUMBER ON HAND, COST PER UNIT AND TOTAL REPLACEMENTS COSTS

FOR CERAMICS MACHINE TOOLS IN PARTICIPATING SCHOOLS

MACHINE TOOLS	NUMBER ON HAND	COST PER UNIT	TOTAL REPLACEMENT COST
Kiln (Cress, Paragon) CSA approved, top loading 23" x 22" c/w automatic shutoff, 230V, 38 amp, automatic timer, installed	11	N.C.A.[a]	
Furnace - enamelling c/w pyrometer CSA (BG Model A-9)	3	N.C.A.[a]	

[a] N.C.A. = No Costs Available

TOTAL REPLACEMENT COSTS FOR HAND TOOLS

Data from Table 20, "Total Replacement Costs for Hand Tools in the Materials Areas of Participating Schools" indicate that costs for all the materials areas involved in the study were not available for each of these areas. These data also show that the hand tools used with material testing would not have to be replaced.

Data from Table 20 show that the most expensive area to convert will be the metals area as far as hand tools are concerned. The total replacement costs for the hand tools used in the metals area would amount to an expenditure of $4,126.45, if purchases were to be made during the 1974-75 fiscal year. The costs of replacing hand tools for the metals area would be highest in urban junior high schools.

Hand tools used in the plastics area would be least expensive to replace. To replace these tools would take an expenditure of approximately $1,096 ($1,095.63).

Data in Table 21, "Total Replacement Costs for Hand Tools in the Technology Areas of Participating Schools" indicate that for the computer, electricity and electronics areas, no replacement of existing hand tools was necessary. Further, these data indicate that the area of graphic communications (drafting) with an expenditure of $7,867.35 will be the most expensive technology area in industrial arts to convert to SI metrics.

The costs for the graphic arts area are not true costs because one item that would require replacement could not be costed out at the time of the study.

The senior high school graphic communications area in a rural setting that participated in this study will be the most expensive to

TABLE 20

TOTAL REPLACEMENT COSTS FOR HAND TOOLS IN THE

MATERIALS AREAS OF PARTICIPATING SCHOOLS

TYPE OF COMMUNITY AND SCHOOL	EARTHS (CERAMICS)	MATERIALS TESTING	METALS	PLASTICS	WOODS
RURAL					
JUNIOR HIGH	NCA	NR	279.09	165.27	235.22
SENIOR HIGH	NCA	NR	1009.27	411.89	639.99
URBAN					
JUNIOR HIGH	NCA	NR	2648.38	444.16	1839.59
SENIOR HIGH	NCA	NR	189.71	74.31	101.30
TOTAL			4126.45	1095.63	2816.10

NCA = No Cost Available
NR = No Replacement

TABLE 21

TOTAL REPLACEMENT COSTS FOR HAND TOOLS IN THE

TECHNOLOGY AREAS OF PARTICIPATING SCHOOLS

TYPE OF COMMUNITY AND SCHOOL	COMPUTERS	ELECTRICITY	ELECTRONICS	GRAPHIC ARTS	GRAPHIC COMMUNICA-TIONS	POWER
RURAL						
JUNIOR HIGH	NR	NR	NR	-	134.45	457.05
SENIOR HIGH	NR	NR	NR	145.95[a]	3896.50	937.78
URBAN						
JUNIOR HIGH	NR	NR	NR	145.80[a]	3761.50	2002.17
SENIOR HIGH	NR	NR	NR	-	74.90	282.53
TOTAL				291.75	7867.35	3679.53

[a] One item not priced
NR = No Replacement

convert. To convert the hand tools in this area would cost $3,896.50 at 1974-75 prices.

The remaining data in this table for replacing the hand tools in both the power area and the graphic arts area can be interpreted in a similar manner.

TOTAL MODIFICATION COSTS FOR MACHINE TOOLS

Data in Table 22, "Total Modification Costs for Machine Tools in the Materials Areas of Participating Schools" indicate that for the ceramics and woods areas no modification costs for machine tools in these two areas were available. For the materials testing area modification of equipment used proved not to be necessary. Further, these data indicate that modification of machine tools in the metals area would be the most expensive of the materials areas to convert. To convert the machine tools in metals, a cost of between $7,668.30 and $10,068.30 would be incurred were these modifications to be made during the 1974-75 fiscal year. One machine tool item was not priced.

For the plastics area, the data in this table may be interpreted in a similar manner to that of the metals area. Four machine tools used in the plastics area were not priced.

Data in Table 23, "Tool Modification Costs for Machine Tools in the Technology Areas of Participating Schools" indicate that for the specific technology areas taught, no modification of machine tools was necessary.

TABLE 22

TOTAL MODIFICATION COSTS FOR MACHINE TOOLS IN THE

MATERIALS AREAS OF PARTICIPATING SCHOOLS

TYPE OF COMMUNITY AND SCHOOL	EARTHS (CERAMICS)	MATERIALS TESTING	METALS	PLASTICS	WOODS
RURAL					
JUNIOR HIGH	NCA	NM	600-800 [a]	26.95 [b]	NCA
SENIOR HIGH	NCA	NM	2340-3040 [a]	107.80 [b]	NCA
URBAN					
JUNIOR HIGH	NCA	NM	4308.30-5708.30 [a]	107.80 [b]	NCA
SENIOR HIGH	NCA	NM	420-520 [a]	26.95 [b]	NCA
TOTAL			7668.30-10068.30	269.50	

[a] One item not priced
[b] Four items not priced
NCA = No Cost Available
NM = No Modification

TABLE 23

TOTAL MODIFICATION COSTS FOR MACHINE TOOLS IN THE TECHNOLOGY AREAS OF PARTICIPATING SCHOOLS

TYPE OF COMMUNITY AND SCHOOL	COMPUTERS	ELECTRICITY	ELECTRONICS	GRAPHIC COMMUNICATIONS	POWER	VISUAL COMMUNICATIONS
RURAL						
JUNIOR HIGH	NM	NM	NM	NM	NM	NM
SENIOR HIGH	NM	NM	NM	NM	NM	NM
URBAN						
JUNIOR HIGH	NM	NM	NM	NM	NM	NM
SENIOR HIGH	NM	NM	NM	NM	NM	NM
TOTAL						

NM = No Modification

CHAPTER V

SUMMARY, OBSERVATIONS, CONCLUSIONS, AND RECOMMENDATIONS

The final chapter of this research study is divided into three sections. The first section is a summary of the research methodology used to conduct the study. The second section deals with observations, conclusions and recommendations that arose from the completion of the research. The third and final section of this chapter deals with the recommendations for further research.

SUMMARY

The Problem

The major objective of this research study was to determine the costs that would be incurred by selected schools offering industrial arts programmes of study in the Province of Alberta, as they convert to the SI system of measurement.

This general objective was supplemented by four ancillary objectives. These four objectives in the study sought to determine the replacement costs for hand tools used in the materials and technology areas of industrial arts; and to determine the modification costs for those machine tools used in materials and technology areas.

Related Literature

A review of the research indices and related literature revealed that there were indeed no other research studies being conducted, or

that were completed in Canada that were similar, or, that had a direct relationship to this investigation.

Publications dealing with related topics were reviewed. Those that were reviewed and reported in this thesis included those that dealt with the history of the metric system, cost analysis as it applies to this study; and industrial arts as it is promulgated in the Province of Alberta. A detailed report of the review of related literature is presented in the second chapter of this report.

Methodology

A major portion of the methodology for the study was the design of the research instrument that would establish an equipment consensus for hand tools and machine tools in industrial arts laboratories that would be affected by conversion to the SI system of measurement.

To design this instrument, equipment lists delineating laboratory tools and machines were obtained from the Consultant for Industrial Arts for the province. These lists served as a baseline for the design of the research instrument. Prior to being used in the major study, the instrument was reviewed by a specialist in instrument design. Following recommendations made by this individual, the research instrument was redesigned and used in a pilot study. The schools selected to participate in the pilot study were not involved in the major investigation.

To determine the population of schools in the province that offer a programme of studies in industrial arts, a list of schools where industrial arts is taught was secured from the Consultant for Industrial Arts for the province. On the list of schools were a total of 311 schools that could be placed in one of the following three categories: junior

high school, junior-senior high school or senior high school.

From this population a stratified random sample of both junior high school and senior high school was taken. The ratio of junior high school to senior high school in the sample was 2:1. The same ratio was applied to sampling urban schools and rural schools.

This technique yielded a total of 18 junior high schools and seven senior high schools. These were stratified into urban and rural schools with a ratio of 2:1.

OBSERVATIONS AND CONCLUSIONS

The following are selected observations made by the researcher in conducting the various phases of the study.

In reviewing the tool catalogues from manufacturers of linear measuring devices it was found that there was an inconsistency of terminology used in describing the various hand tools. For instance: in one tool catalogue that was reviewed, a square - sliding T-8" was called a "square bevel 8 in.". In another catalogue that was reviewed the same measuring device was called an "adjustable bevel". There were other similar instances such as that just described that were found for other hand tools in the catalogues that were reviewed.

It was observed that the listing of catalogue numbers and trade names on the research instrument for hand tools and machine tools may have prevented participating teachers from completing certain portions of the research instrument. These participating teachers may have had the opinion that because they had a tool or machine with a different catalogue number, or manufacturer, that they did not have that piece of

equipment in their laboratory. Because of this they may not have included the hand tool or machine tool on the research instrument.

It was observed that the listing of hand tools by sets, for instance a set of socket wrenches 1/4" drive, may have prevented teachers from completing this part of the instrument. Those teachers who did not complete this statement may have had only a partial set and therefore may have omitted responding to statements on the instrument dealing with "sets of tools".

It was observed that in contacting vendors that supply the various hand tools and machine tools to industrial arts laboratories that they - the vendors - were most cooperative in furnishing the information requested. Many of these vendors expressed a definite interest in the results of the study when it is completed.

It was observed that in attempting to secure the costs of replacement kits or parts for machine tools that would be affected by metric conversion, that many of the vendors could not supply the requested information. This inability to quote a price for a modification kit by vendors was because manufacturers who supply them were not ready to commit the proportion of their plants to making conversion kits.

It was observed that where gauges are used to measure the flow of a gas or liquid, or to measure a temperature, it will be required that such measuring devices be completely replaced by gauges or thermometers graduated in SI units. For instance a gauge used to measure pounds per square inch (p.s.i.), will have to be totally replaced by a gauge that measures kilopascals (kPa).

It was observed that although 19 machine tools were identified

in the research, less than half (7) had a modification part or replacement part manufactured and priced. It is evident that manufacturers of machine tools for industrial arts laboratories are not committing their plants to manufacturing metric parts or units until the federal government promulgates a set policy with reference to conversion dates.

It was observed from the "Other" category of the research instrument that additional hand tools could have been included on the instrument but were not. Hand tools, such as auger bits, forstner bits, drill bits of different sizes and lengths, are a few of the hand tools that could have been added to the "Other" category by participants.

It was observed that there are a wide variety of lathes with different swing size, bed length, and trade name in the industrial arts laboratories in the province.

RECOMMENDATIONS

The following recommendations are the results of the findings of this study:

1. It is recommended that wherever possible, that tools or machines replaced because of loss or breakage be charged against normal replacement costs and not to the cost of conversion.
2. It is recommended that each school jurisdiction establish a set policy with reference to the purchase of hand tools or machine tools with metric capabilities.
3. It is recommended that the manufacturers of hand tools in particular, have their professional organizations establish

a standard name for each tool that could be used by both layman and tradesman who may use that tool at home or in a trade. This recommendation is made so that the names of tools can become standardized not only in Canada but in the rest of the world.

4. It is recommended that metric conversion for industrial arts laboratories be on a three-phase transitional basis, starting with the 1975-76 school year.

The first phase would involve the short term where steps may be taken immediately, or may have already been taken, in conversion, though involving no great expense. The aim would be to increase the use of SI units of measurement in all branches of industrial arts and related studies. This would familiarize students with the SI metric system of measurement, through the use of charts, tables and other aids.

The second or middle stage would entail the replacement of some hand tools and some modification and possible replacement of some machine tools. This would be accomplished by the teacher purchasing a limited number of metric linear devices for both the materials and technologies areas of his laboratory.

The third and final stage, or the long term stage, would be where SI attains the status of being the preferred system of measurement with the schools following the example as set by federal and provincial governments and industries. At this stage the hand tools and machine tools used in industrial

arts laboratories to support instruction would be metric.

RECOMMENDATIONS FOR FURTHER RESEARCH

The following recommendations are made for those who may want to replicate this study or initiate research closely related to this study.

1. It is recommended that the machine tool portion of this study be replicated in 18 months to determine if manufacturers have available modification kits or parts. This research could also identify whether costs for these kits or parts have increased or decreased because of demand.
2. It is recommended that in conducting such a study as in "Recommendation 1" that the entire population of industrial arts laboratories in the Province of Alberta be included in that study. This procedure should yield a more accurate equipment census for both the hand tools and machine tools found in industrial arts laboratories.
3. It is recommended that should this study be replicated, that the research instrument be revised, and used in a pilot study. This recommendation is made so that "sets of tools" may be broken down into component parts; and trade names removed from the instrument; such as the length of a 150 mm rule remains constant regardless of who manufactures the rule.

BIBLIOGRAPHY

BOOKS

Burke, A. J. Financing Public Schools in the United States. New York: Harper Brothers, 1957.

Canadian Teachers' Federation. Financing Education in Canada. Ottawa, 1962.

Cochran, L. H. Innovative Programs in Industrial Education. Bloomington, Illinois: McKnight & McKnight, 1970.

Feirer, J. L. and Lindbeck, J. R. Industrial Arts Education. New York: Center for Applied Research in Education, Inc., 1964.

Ferguson, G. A. Statistical Analysis in Psychology and Education. New York: McGraw-Hill Book Company, 1971.

Fowlkes, J. G. and Hensen, A. L. "Business Management - Accounting, Auditing and Reporting," in Problems and Issues in Public School Finance. Edited by Johns, R. L. and Morphet, F. L., New York: National Conference on Professors of Educational Administration, 1952.

Government of Alberta. Junior and Senior High School Handbook. Edmonton, The Department of Education, 1974-75.

Government of Canada. White Paper on Metric Conversion in Canada. Ottawa: Government of Canada, 1970.

Groner, A. and Boehm, G. A. Going Metric - An AMA Survey Report. New York: AMACOM, 1973.

Hanson, Eric J. Financing Education in Alberta. Research Monograph No. 14. Edmonton: The Alberta Teachers' Association, March, 1969.

Hollis, W. S. "The Industrial Scene" in Metrication. Edited by F. W. Kellaway, Middlesex, England: Penguin Books Ltd., 1970.

Irwin, K. G. The Romance of Weights and Measures. New York: The Viking Press, 1960.

Kellaway, F. W. (ed.). Metrication. Middlesex, England: Penguin Books Ltd., 1970.

Kisch, B. Scales and Weights (An Historical Outline). New Haven: Yale University Press, 1965.

Knezevich, Stephen J. and John Guy Fowlkes. Business Management of Local School Systems. New York: Harper Brothers, 1960.

Knezevich, Stephen J. "Resources Management and Educational Logistics." The Theory and Practice of School Finance. Edited by W. E. Gauerke and J. R. Childress. Chicago: Rand McNally & Company, 1967.

Leggett, R. F. Standards in Canada. Ottawa: Information Canada, 1971.

Lighthill, M. F. 'Metrication in Science and Technology," in Metrication. Edited by F. W. Kellaway, Middlesex, England: Penguin Books Ltd., 1970.

Mort, P. R., Reusser, W. C. and Polley, J. W. Public School Finance: Its Background, Structure and Operation. New York: McGraw-Hill Book Company, Inc., 1964.

Ollivier, M. "The British North America Acts and Selected Statutes 1867-1962." House of Commons. Ottawa: Queen's Printer and Controller of Stationary, 1962.

Osview, C. and Castetter, W. B. Budgeting for Better Schools. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1960.

The Royal Society. Metrication in Schools II. Report of Conference on September 19, 1968. London: The Royal Society, January, 1969.

Schools Council. Measure for Measure: A Guide to Metrication for Workshop Crafts and Technical Studies. London: Evans Brothers, 1970.

Silvius, G. H. and Bohn, R. C. Organizing Course Materials. Bloomington, Illinois: McKnight & McKnight, 1961.

The Canadian Pocket Encyclopedia. 28th ed. Toronto: Quick Canadian Facts Ltd., 1972.

United States Department of Commerce. The English and Metric Systems of Measurement. Washington: U.S. Government Printing Office, 1969.

United States Metric Study. A Metric America, A Decision Whose Time Has Come. Washington: U.S. Government Printing Office, 1970.

Vaizey, J. and Chesswas, J.D. The Costing of Educational Plans. Italy: Unesco-International Institute for Educational Planning, 1967.

Van Ren Haag, E. Education as an Industry. New York: August M. Kelly, 1956.

PERIODICALS

Bank of Montreal. "Canada Prepares for Metric Conversion." Business Review. January, 1974.

Commercial Newsletter. The Canadian Imperial Bank of Commerce, September, 1968.

Harder, J. D. "The Alberta Industrial-Arts Program." School Shop. Vol. 28, November, 1968.

Hopkins, R. A. "A Metric System." American Metric Journal. November/December, 1974.

Johnson, R. F. "Metric Education Association Formed." Metric News. Vol. 2, No. 3, January/February, 1975.

Mettler, A. J. "The Metric System." Engineering Digest. June, 1972.

Ritchie - Calder. "Conversion to the Metric System." Scientific American. Vol. 223, No. 1, July, 1970.

Stockton, P. D. H. and Flanigan, I. M. "What Everyone Should Know About Educational Finance." National Education Association Journal, 1969.

UNPUBLISHED WORKS

Gossage, S. M. (Chairman of the Metric Commission.) Unpublished paper presented to the Alberta Invitational Conference on Metric Conversion, Edmonton, October, 1973.

Jeffery, J. A. "Metrication." Unpublished paper presented to the Department of Education, The University of Alberta, September, 1973.

Torgunrud, E. (Director of the Curriculum Branch, Department of Education, Alberta.) In addressing the Alberta Invitational Conference on Metric Conversion, Edmonton, October, 1973.

APPENDIX A

IN THIS APPENDIX CAN BE FOUND COPIES OF CORRESPONDENCE RELATED TO THE STUDY. LETTERS SENT TO:

METRIC COMMISSIONS OR METRIC BOARDS

TEACHERS UNIONS

DEPARTMENTS OF EDUCATION (ENGLAND)

INDIVIDUAL TEACHERS

A LIST OF COUNTY DEPARTMENTS OF EDUCATION (ENGLAND) CAN ALSO BE FOUND IN THIS APPENDIX.

FACULTY OF EDUCATION
DEPARTMENT OF INDUSTRIAL AND
VOCATIONAL EDUCATION
TELEPHONE (403) 432-3678

QUAECUMQUE VERA

THE UNIVERSITY OF ALBERTA
EDMONTON, ALBERTA, CANADA
T6G OY1

LETTER SENT TO METRIC BOARDS

October 3, 1973

Dear

At the present time I am on a year's leave of absence from the Edmonton Public School Board where I was employed as an industrial arts teacher. This leave has enabled me to enrol at The University of Alberta where I am completing the requirements for a Master's Degree in Education.

Being involved in industrial arts, I have become concerned with the conversion of the metric system and its implications to industrial arts and the total educational community; especially in the light of the publication on Metric Conversion in Canada by the Federal Government.

Under the guidance of Dr. C. Preitz, of this department, I have selected as my research topic, Metric Conversion and Some of Its Implications for Education - particularly cost of conversion.

From correspondence with the Metric Commission of Canada I have received an information booklet which indicates that informational material on some of the aspects of metrication is available from your organization. It would be appreciated if you would forward me the information which I might use in my research. Should any costs be incurred, would you please bill me for same.

Yours faithfully,

Christopher Harrison
Graduate Student

Clarence H. Preitz (Dr.)
Department Advisor

FACULTY OF EDUCATION
DEPARTMENT OF INDUSTRIAL AND
VOCATIONAL EDUCATION
TELEPHONE (403) 432-3678

QUAECUMQUE VERA

THE UNIVERSITY OF ALBERTA
EDMONTON, ALBERTA, CANADA
T6G OY1

LETTER SENT TO TEACHERS UNIONS

October 5, 1973

Dear

At the present time I am on a year's leave of absence from the Edmonton Public School Board where I was employed as an industrial arts teacher. This leave enabled me to enrol at The University of Alberta where I am completing the requirements for a Master's Degree in Education.

Being involved in industrial arts, I have become concerned with the conversion to the metric system and its implications to industrial arts and the total educational community; especially in the light of the publication on Metric Conversion in Canada by the Federal Government.

Under the guidance of Dr. C. Preitz, of this department, I have selected as my research topic, Metric Conversion and Some of Its Implications for Education; particularly cost of conversion.

From correspondence with the Royal Society, I have received information that Mr. K. B. Rook, Chairman of the Teachers' Sub-Association of the Bradford Branch of the National Union of Teachers has conducted a study into the metrication in school workshops. In researching the various libraries on campus I find that the results of the study are not available.

It would be appreciated if you could provide me with a copy of Mr. Rook's study, providing it is still available. Should this prove impossible because of the time lag that has occurred, could I request that you send me an address where I might further contact Mr. Rook.

Thank you for your cooperation.

Yours faithfully,

Christopher Harrison
Graduate Student

Clarence H. Preitz (Dr.)
Department Advisor

FACULTY OF EDUCATION
DEPARTMENT OF INDUSTRIAL AND
VOCATIONAL EDUCATION
TELEPHONE (403) 432-3678

QUAECUMQUE VERA

THE UNIVERSITY OF ALBERTA
EDMONTON, ALBERTA, CANADA
T6G 0Y1

LETTER SENT TO INDIVIDUAL TEACHERS

October 12, 1973

Dear

At the present time I am on a year's leave of absence from the Edmonton Public School Board where I was employed as an industrial arts teacher. This leave has enabled me to enrol at The University of Alberta where I am completing the requirements for a Master's Degree in Education.

Being involved in industrial arts, I have become concerned with the conversion of the metric system and its implications to industrial arts and the total educational community; especially in the light of the publication on Metric Conversion in Canada, by the Federal Government.

Under the guidance of Dr. C. Preitz of this department, I have selected as my research topic, Metric Conversion and Some of Its Implications for Education; particularly cost of conversion.

From correspondence with the Royal Society and National Union of Teachers, I gather that you were the Chairman of the Teachers' Sub-Association of the Bradford Branch of the National Union of Teachers, which conducted a study into the topic of - "Metrication in School Workshops'. In researching the various libraries on campus I find that the results of the study are not available through any source.

It would be appreciated if you could provide me with a copy of the study you conducted along with further supplementary reports which may have arisen from the original report. Should any costs be incurred, would you please bill me for same.

Yours faithfully,

Christopher Harrison
Graduate Student

Clarence H. Preitz (Dr.)
Department Advisor

FACULTY OF EDUCATION
DEPARTMENT OF INDUSTRIAL AND
VOCATIONAL EDUCATION
TELEPHONE (403) 432-3678

QUAECUMQUE VERA

THE UNIVERSITY OF ALBERTA
EDMONTON, ALBERTA, CANADA
T6G 0Y1

LETTER SENT TO DEPARTMENTS OF EDUCATION (ENGLAND)

November 1, 1973

Dear

At the present time I am on a year's leave of absence from the Edmonton Public School Board where I was employed as an industrial arts teacher. This leave has enabled me to enrol at The University of Alberta where I am completing the requirements for a Master's Degree in Education.

Being involved in industrial arts, I have become concerned with the conversion of the metric system and its implications to industrial arts and the total educational community; especially in the light of the publication on Metric Conversion in Canada, by the Federal Government.

Under the guidance of Dr. C. Preitz, of this department, I have selected as my research topic, Metric Conversion and Some of Its Implications for Education; particularly cost of conversion.

From correspondence with the National Union of Teachers, I find that your department may have conducted some form of study into the projected cost of metric conversion, especially within the realms of the technical departments.

Should this be the case, it would be appreciated if you would forward me a copy of such studies that were completed with regard to my current research. Should any costs be incurred, would you please bill me for same.

Yours faithfully,

Christopher Harrison
Graduate Student

Clarence H. Preitz (Dr.)
Department Advisor

LIST OF COUNTY DEPARTMENTS OF EDUCATION (ENGLAND)

Education Officer
Department of Education
County Hall
Bedford
Bedfordshire

Shire Hall
Reading
Berkshire

County Offices
Aylesbury
Buckinghamshire

County Hall
Chester
Cheshire

County Hall
Truro
Cornwall

County Hall
Exeter
Devon

County Hall
Durham
Durham

County Hall
Chelmsford
Essex

Shire Hall
Glouster
Gloustershire

The Castle
Winchester
Hampshire

Springfield
Maidstone
Kent

County Hall
West Bridgeford
Nottinghamshire

County Hall
Taunton
Somerset

Shoreditch College of Education
Cooper's Hill
Englefield Green
Egham
Surrey

County Hall
Kingston-on-Thames
Surrey

The Grove
Carshalton
Sutton
Surrey

County Hall
Lewis
Sussex

22 Northgate Street
Warwick
Warwickshire

County Education Office
Bond Street
Wakefield
Yorkshire

APPENDIX B

A COPY OF THE RESEARCH INSTRUMENT

CAN BE FOUND IN THIS APPENDIX

RESEARCH INSTRUMENT

Topic: Metric Conversion Costs for Industrial Arts in the Province of Alberta

Directions to Participants:

1. This research insturment consists of the following parts:

   (a) School Profile Information
   (b) Industrial Arts Profile Information
   (c) Research Instrument for both hand tools and machine tools

   Please respond to each statement as directed in the explanatory note provided for each part.

2. When dealing with the section on hand tools, please enter the appropriate number of items on hand in the designated column. Should you have hand tools requiring replacement due to conversion to SI units, that are not listed, please enter them under the section titled "Other". Example:

	Number on hand
Micrometer 1"	3
Rules 6" steel	24
Rules 12" steel	36
Other:	
Micrometer 1"-2"	1

3. In dealing with the section on machine tools, please enter the appropriate number of items on hand in the designated column. Should you have machine tools requiring modification or replacement due to conversion to SI units, that are not listed, please enter them under the section titled "Other". Example:

	Number on hand
Lathe - engine (Myford M-7, South Bend CL-6702 Boxford), 7-10" swing	1
Other:	
Lathe, engine (Harrison), 13" swing	1

School Profile Information:

Name of School: ______________________________

Address: ______________________________

Type of School: (check one)	Junior High School	______
	Junior/Senior High School	______
	Senior High School	______
Type of Community: (check one)	Rural	______
	Urban	______
	Suburban	______
Student Enrolment: (check one)	0- 299	______
	300- 499	______
	500- 699	______
	700- 899	______
	900-1099	______
	1100-1499	______
	1500-1999	______

Grades Taught: (check those applicable) 7____ 8____ 9____ 10____ 11____ 12____

Industrial Arts Profile Information:
(check those applicable within your lab situation)

Materials Areas:	Metals	______
	Plastics	______
	Woods	______
	Earths	______
	Materials Testing	______
Technology Areas:	Visual Communications	______
	Graphic Communications	______
	Electricity	______
	Electronics	______
	Computers	______
	Power	______

Number of students enrolled within industrial arts progamme of study ______

RESEARCH INSTRUMENT FOR METRIC CONVERSION COSTS

Metalwork

Hand Tools:

	Number on hand
Micrometer - 1" (B & S #599-4)	
Rules - 6" Steel	
Rules - 12" Steel	
Square - Combination 12" (Stanley #H1222 1/2)	
Square - Combination Set - 12" steel rule, centre head, protractor head (Miller Falls 1274)	
Squares - Tri 6" (Stanley #12TS)	
Tap and Die Set - Machine, Screw up to 5/8" NC-NF (Butterfield)	
Tape - 10'	
Wrenches - Set - Allan Long Stem 5/64"-3/8"	
Wrenches - Set - Combination 1/4"-7/8" in 1/16"	
Other:	

Machine Tools:

	Number on hand
Grinder - 7" Bench Type c/w lighted safety eyeshield, wheel guards, tool rests, water pot, 1/2 HP, 3450 RPM c/w 2 coarse grinding wheels (Delta)	
Lathe - engine (Myford M-7, South Bend CL-6702, Boxford), 7-10" swing, 22" between centres, all guards, quick change gear box, 1/2 HP-110 V-1/60 motor c/w drum switch, taper attachment, thread dial indicator, revolving head knurling tool, fitted 5" 3-jaw universal chuck, fitted 6" 4-jaw independent chuck, 1/2" capacity, 6-7" face-plate, tool steel centres, taper shank arbor; straight, right-hand, left-hand cutting-off tool holder, 6 ground cutter bits, 6 unground cutter bits, boring tool holder, tray, revolving centre for tail-stock, safe work light, lathe cover	
Milling machine - horizontal (Tom Senior), 7 1/2" swing dividing head, 1" raising blocks and chuck, 8" diameter rotary S type table, 4" vise, cutter guard, collett chuck, 110/220/1/60 1 HP motor	

Hand Tools:

	Number on hand
Other: (continued)	

Machine Tools:

	Number on hand
Lathe - engine metal bench Model 10" (South Bend, Boxford), 110/1/60 motor, drum switch, thread dial indicator, taper attachment, knurling tool, threading tool, 5" 3-jaw universal chuck, Jacob's 12" chuck and taper shank arbor, straight-right-left hand turning tool holder, RH cutting-off tool holder, 6 ground cutter bits, 12 unground cutter bits, boring tool holder, independent 4-jaw chuck with reversible jaws	
Milling Machine - horizontal (Hamilton XM-20 Burke) c/w installed slow speed attachment, motor, manual, switch, belt guard, cut-off switch, over-arm assembly, milling arbor, drawbar, milling vise, slitting saw, 1/8" side mill cutter, 3/16" and vertical milling machine (Hamilton) c/w motor, manual, switch, drill chuck 1/4", end mill adaptor, shell mill holder, drawbar, milling vise, end mill 3/8", shell end mill 1 1/4"	
Milling Machine accessory package - plain milling cutter, 2 1/2 x 1/4, 2 1/2 x 3/16, 2 1/2 x 3/8, 2 1/2 x 6/16, side milling cutter 3 x 1/4, slitting	

Hand Tools:

Machine Tools:

	Number on hand
cutter 4 x 1/16, double angle cutter 60°, 2 3/4 x 1/2, convex milling cutter 2 1/2 x 1/2, vertical milling cutter 1/8, 1/4, 3/8, 1/2	
Welding - gas (Purox 40L41W-275A) medium duty welding and cutting outfit c/w W275 torch, CW275 cutting attachment, #6, #12, #30 welding heads, #5 cutting nozzle, single stage oxygen and acetylene regulators, 25"-3/16 twin hose, 3 pr. #21-N goggles, friction lighter, wrench, tip cleaner, oxygen and acetylene check valves and complete instructions	
Other:	

Plastics

Hand Tools:

	Number on hand
Drill and Countersink 1/8" (Marshall Wells #13-8721)	
Drill and Countersink 3/16" (Marshall Wells #13-8722)	
Rule - 12" Steel (Rabone)	
Rule - 36" Steel	
Saw Blade - to fit circular or radial arm saw	
Scales - spring 1-25 Lbs. lab type (#6561 Hansen)	
Square - Combination Set 12", 4 pcs.	
Square - Tri 6" (Stanley 12TS)	
Tape - 10'	
Other:	

Machine Tools:

	Number on hand
Air Compressor - portable - quick disconnect fittings 2, 20 gal. pressure 100 lbs. (Micro-Lyn #46)	
Press - Laminating (Wabash #12-10-2TWC) c/w thermoset kit, laminating kit, rubber stamp kit, compression molding kit	
Rotational Molder - (Vega #14), thermostat control, timer, pilot light c/w molds - 3 animals, shakers ball, cube, wheel, freezer can	
Strip Heater - 500 watt element, pilot light, 6 feet grounded cord, thermostat control	
Vacuum & blow forming unit (Model CT1214 or TP-1612), 110V motor, self-contained vacuum pump, air hose & quick connect couplines c/w molds - bowl, tray, lantern	
Other:	

Woodwork

Hand Tools:

	Number on hand
Bit - expansive (Walter Woods 3A587-22)	
Bits - set - Forstner 3/8", 1/2", 5/8", 3/4", 1"	
Wing - set - 13 prcs., 5/16"-1" in 1/16" (Irwin)	
Circle Cutter 1"-5" (#418 Stanley)	
Countersink 1/4" shank 5/8" dia. 82° (Stanley #137)	
Drills - set - HSS steel by 1/64-1/2" c/w index	
Plug Cutter - set - 3/8", 1/2", 5/8"	
Rules - 12" steel (Rabone #25)	
Sanding Drum - 1" dia.	
Sanding Drum - 3" dia.	
Square - Frame 16x24 (Stanley #R100)	
Squares - Tri 6" (Stanley #12)	
Square - Combination 12" (Stanley #22)	
Square - Sliding T 8" (Stanley #25TB)	
Tape - steel 8' (Stanley #120W)	

Machine Tools:

	Number on hand
Grinder - (Stanley #697) Edge Tool c/w #600 "Flud-lite" eyeshields, 2 grinding wheels, 1 coarse MS373, 1 extra fine MS476, heavy duty switch, 1/3 HP motor, split phase, 110V with grounded attachment cord, edge tool grinding attachment	
Saw - Circular 8" tilting arbor (General or Delta) c/w jet-lock fence, combination blade, mitre gauge, front graduated bar, rear guide bar, table insert, 1 1/2 HP electric motor, 120/208 V/1/60 single phase 3450 RPM, magnetic switch, dado set & insert, extension wings, rip blade, plywood blade, Brett guard	
Saw - Circular 10" tilting arbor (General or Delta Unisaw) c/w jet-lock fence, combination blade, mitre gauge, front graduated bar, rear guide bar, dado head set and table insert, cast iron side wings, 10" rip blade, 10" plywood blade, single phase 208 V - 3450 RPM, 1 1/2 HP, magnetic switch Brett guard, ready to operate	

Hand Tools:

	Number on hand
Wrenches - set - combination 3/8, 1/16, 1/2, 9/16, 5/8, 11/16, 3/4, 7/8	
Other:	

Machine Tools:

	Number on hand
Saw - Radial Arm 10", 2 HP 110/220/1/60 motor, automatic brake, enclosed stand, guards, 10" plywood blade, 10" combination blade, dado set and guard (Craftsman)	
Wood Welder, 3/4 118 (Workrite Model 1500)	
Other:	

Ceramics

Hand Tools:

	Number on hand

Machine Tools:

	Number on hand
Furnace - enamelling c/w pyrometer CSA (BG Model A-9)	
Kiln (Cress, Paragon) CSA approved, top loading 23" x 22" c/w automatic shut-off, 230V, 38 am., intermatic timer, installed	
Other:	

Photography

Hand Tools:

Item	Number on hand
Graduate - 8 oz., 16 oz., 32 oz., darkroom (Kodak)	
Thermometer - darkroom, tank and tray, stainless steel	
Other:	

Machine Tools:

Item	Number on hand

Graphic Communications (Drafting)

Hand Tools:

Item	Number on hand
Drafting Machine 18" c/w 1/8"-1/4" and 1/2"-1" clear plastic scales (Paragon Junior)	
Parallel Rule (30"x42" table)(Mayline)	
Scales - Architect's 12" plastic (K&E #18881(	
Scales - Engineer's 12" plastic (Norman Wade DS49-380)	
Table - Drafting (Norman Wade DF105520) 30"x42" c/w covering	
Table - Drafting (Nikette Model 312-2031) 30"x42" c/w covering	
T-Square - 24"	
Drafter - Track c/w 1/8"-1/4" & 1/2"-1" clear plastic scales to fit 30"x42" table (Mutoh)	
Other:	

Machine Tools:

Item	Number on hand

Graphic Arts

Hand Tools:

	Number on hand
Cutter - power paper 15" (Triumph 15E)	
Typewriter - c/w 4 elements, 12 pitch #005, #090, #053, #085 (IBM Selectric 713)	
Duplicator - Offset, single lever control (A.B. Dick 350, Am 1250, Gestetner 201)	
Punching & Binding Unit (GB Super Combo)	
Typewriter - c/w 15" carriage, carbon ribbon, 4 elements, 12 pitch, #005, #090, #053, #085 (IBM Selectric 713)	
Other:	

Machine Tools:

	Number on hand

Power

Hand Tools:

	Number on hand
Gasoline Can - 1 gallon safety type (Protectoseal)	
Gauge - Compression, 0-300 PSI (Allen 17-02)	
Gauge - set of Feeler - 25 3" blades, 10015-040 (Proto Book)	
Gauge - Spark Plug wire type c/w electrode bender (Gray FG-7)	
Punches, set - Pin, 1/8", 3/16", 11/64"	
Rule - 12" steel in 64th (Rabone #25)	
Screwdrivers, set - sq. shank, 1/8", 3/16", 5/16", 3/8"	
Tachometer (#757 Stewart Warner)	
Wrench - set, combination 1/4"-7/8" in 16th (Durochrome)	
Wrench - socket, spark plug 1/4" drive, 13/16" c/w special rubber insert	
Wrenches, set - Socket - 16 pcs., 6 pt., 1/4" drive, 3/16"-1/2" c/w ratches, handles, extensions	

Machine Tools:

	Number on hand

Hand Tools:

Hand Tools	Number on hand
Wrench - Torque 1/4" drive, 0-300 in. lbs. (Proto Torquemaster, Durochrome, Gray)	
Small engine tool kit #291661 (Briggs & Stratton)	
Compression Tester c/w remote start (Allen 50-217)	
Engine Analyser (Allen 1094) c/w training materials	
Engine Analysis System (Go-Power DA) for multi-cylinder engines	
Scope, ignition simulator (Allen 30-34AC)	
Flaring Set - 3/16"-5/8"	
Gauge - vacuum & pressure - 0-30"	
Micrometer - 0-4" (B & S 59940-3)	
Tube Cutter - 1/8"-1 1/8"	
Wrench - Torque - 3/8" drive 10-150 lbs. (roto Torquemaster or Durochrome)	

Machine Tools:

Machine Tools	Number on hand

Hand Tools:

	Number on hand
Wrenches - set - ignition	
Wrenches - set - Sockets, 16 pcs., 12 pt., 3/8" drive, 3/8"-7/8", 5 extensions, 17" speed handle, flex handle, universal joint, reversible ratchet	
Wrenches - set - Tappet - 3/8 x 7/16, 1/2 x 9/16	
Other:	

Machine Tools:

	Number on hand

APPENDIX C

THIS APPENDIX INCLUDES A SAMPLE LETTER SENT TO SUPERINTENDENTS OF SCHOOLS ASKING THEIR COOPERATION IN THE STUDY.

ALSO INCLUDED IS A LIST OF THE NAMES AND ADDRESSES OF SUPERINTENDENTS WHO PARTICIPATED IN THE STUDY.

FACULTY OF EDUCATION
DEPARTMENT OF INDUSTRIAL AND
VOCATIONAL EDUCATION
TELEPHONE (403) 432-3678

THE UNIVERSITY OF ALBERTA
EDMONTON, ALBERTA, CANADA
T6G OY1

SAMPLE LETTER TO SUPERINTENDENTS OF SCHOOLS

April 5, 1974

Dear

At the present time I am on leave from the Edmonton Public School Board, where I am a teacher of industrial arts. I am enrolled in the Faculty of Graduate Studies and Research where I am completing the requirements for a Master of Education degree. Part of these requirements include the completion of a formal thesis.

The research for my thesis will centre around costs of conversion from the imperial system of measurement to that of the Systeme International d'Unites (SI), in industrial arts. The title of my thesis is "Metric Conversion Costs in the Province of Alberta".

Part of the research design for this study involves industrial arts teachers from selected schools in the province. Using a table of random numbers a school within your jurisdiction was identified to be involved in the study.

The purpose of this correspondence is to secure your cooperation by permitting your industrial arts teachers to be included in the study. Their responsibility will be to complete a research instrument, and to return it to the researcher.

In order for me to stay within the time limit I have established, may I ask that you indicate a favourable reply by returning the enclosed form to me by April 10, 1974. To assist you, I have enclosed a self-addressed stamped envelope.

An abstract of the study will be made available to those who participate in the study.

Your interest and cooperation in this study will be sincerely appreciated.

Yours faithfully,

R. Christopher J.L. Harrison

This return slip will give the researcher, R. Christopher J. L. Harrison, permission to seek the relevant data from industrial arts teachers within my school jurisdiction, for the purpose of his thesis research.

Signed: ______________________________

Date: ______________________________

NAMES & ADDRESSES OF SUPERINTENDENTS WHO PARTICIPATED IN THE STUDY

F. Begoray
Superintendent of Schools
Box 540
Athabasca

H. Treleaven
Superintendent of Schools
Barrhead

Dr. Carl Safran
Superintendent of Schools
Calgary S.D. No. 19
Education Centre Building
515 Macleod Trail S.E.
Calgary

J. V. VanTighem
Superintendent of Schools
Calgary R.C.S.S.D. No. 1
Catholic School Centre
300 - 6 Avenue S.E.
Calgary

D. G. Green
Superintendent of Schools
Box 160
Fort Vermilion

Dr. O. P. Larson
Superintendent of Schools
Lethbridge S.D. No. 51
433 - 15 Street S.
Lethbridge

F. B. Allore
Superintendent of Schools
Medicine Hat R.C.S.S.D. No. 21
73 - 7 Street S.E.
Medicine Hat

Dr. R. L. Shields
Superintendent of Schools
Box 269
Oyen

T. D. Shields
Superintendent of Schools
Box 339
Peace River

W. Bodnaruk
Superintendent of Schools
Box 549
Ponoka

R. F. McCormick
Superintendent of Schools
Box 337
Provost

APPENDIX D

A SAMPLE COPY OF THE LETTER SENT TO EACH PARTICIPATING INDUSTRIAL ARTS TEACHER IS PART OF THIS APPENDIX. THE REMAINING PART IS A LIST OF THE NAMES AND ADDRESSES OF THOSE INDUSTRIAL ARTS TEACHERS WHO WERE INVOLVED IN THE STUDY.

IN ADDITION, A COPY OF THE FOLLOW-UP LETTER CAN BE FOUND IN THIS APPENDIX.

FACULTY OF EDUCATION
DEPARTMENT OF INDUSTRIAL AND
VOCATIONAL EDUCATION
TELEPHONE (403) 432-3678

QUAECUMQUE VERA

THE UNIVERSITY OF ALBERTA
EDMONTON, ALBERTA, CANADA
T6G OY1

SAMPLE COPY OF LETTER SENT TO EACH PARTICIPATING INDUSTRIAL ARTS TEACHER

April 23, 1974

Dear

Recently I wrote to the superintendent of your school jurisdiction asking for his cooperation to involve you in a research project that I am conducting. This cooperation was readily granted by the superintendent.

At the present time I am on leave of absence from my industrial arts teaching position with the Edmonton Public School Board so that I might complete my Master's degree. For my thesis research I am conducting a study entitled "Metric Conversion Costs for Industrial Arts in the Province of Alberta".

Part of the research design for my study requires that selected industrial arts teachers complete a research instrument. Through a standard selection procedure used in research your name was selected as a participant.

Enclosed is a copy of the research instrument which should take approximately one-half hour to complete. After you have completed it, please place the instrument in the enclosed stamped-addressed envelope and return it to me by May 10, 1974.

All data collected by the researcher will be treated as privileged information.

A copy of the abstract of the study will be sent to all participants. May I express my appreciation for your anticipated assistance in the completion and early return of the research instrument by the above date.

Yours faithfully,

R. Christopher J. L. Harrison
Graduate Student
Department of Industrial and
Vocational Education

Enclosures

FACULTY OF EDUCATION
DEPARTMENT OF INDUSTRIAL AND
VOCATIONAL EDUCATION
TELEPHONE (403) 432-3678

THE UNIVERSITY OF ALBERTA
EDMONTON, ALBERTA, CANADA
T6G 0Y1

QUAECUMQUE VERA

COPY OF FOLLOW-UP LETTER TO EACH PARTICIPATING INDUSTRIAL ARTS TEACHER

May 15, 1974

Dear

Recently a research instrument intended to provide information to assess Metric Conversion Costs for Industrial Arts in the Province of Alberta was mailed to you.

In view of your professional judgment for the purpose of this research and the deadline which has been set for completion, please take a few moments from your schedule to complete the survey instrument and return it immediately, if possible.

Hopefully, the research instrument has been planned so that the time you spend on it will be minimal.

Your contribution is imperative for the completion of this study and your response would be greatly appreciated.

Yours truly,

R. Christopher J. L. Harrison
Graduate Student
Department of Industrial and
Vocational Education

NAMES & ADDRESSES OF INDUSTRIAL ARTS TEACHERS INVOLVED IN THE STUDY

Mr. D. Warawa
Industrial Arts Department
Assumption Indian Day School
Assumption T0H 0C0

Messrs. W. Ellerington
F. Godberson
W. Ruhl
Industrial Arts Department
Jorne Jenken Senior High School
Barrhead T0G 0E0

Mr. L. Cross
Industrial Arts Department
Boyle School
Boyle T0A 0M0

Messrs. E. Firmaniuk
M. Rybchuk
Industrial Arts Department
St. Margaret School
3320 Carol Drive N.W.
Calgary T2L 0K7

Mr. S. J. Soltes
Industrial Arts Department
Ernest Morrow Junior High School
1212 - 47 Street S.E.
Calgary T2A 1R3

Mr. E. R. Everingham
Industrial Arts Department
Georges P. Vanier Junior High School
509 - 32 Avenue N.E.
Calgary T2E 2H3

Mr. P. D. Leavitt
Industrial Arts Department
Simon Fraser Junior High School
5215 - 33 Street N.W.
Calgary T2L 1V3

Messrs. J. Friesen
L. Harris
N. Horlacher
T. Sterenberg
Industrial Arts Department
Kate Andrews High School
Box 1120
Coaldale T0K 0L0

Mr. G. Starko
Industrial Arts Department
H. E. Beriault Junior High School
8125 - 167 Street
Edmonton T5R 2T7

Mr. R. G. Willis
Industrial Arts Department
Sir John Thompson Junior High School
13525 - 132 Avenue
Edmonton T5L 3R6

Mr. J. Shore
Industrial Arts Department
St. Nicholas Junior High School
3643 - 115 Avenue
Edmonton T5W 0V1

Messrs. M. Palichuk
B. Sokoluk
Industrial Arts Department
Balwin Junior High School
7055 - 132 Avenue
Edmonton T5C 2A7

Mr. G. Skeels
Industrial Arts Department
H. A. Gray Junior High School
12140 - 103 Street
Edmonton T5G 2J9

Mr. C. Bryan
Industrial Arts Department
McKernan Junior High School
11330 - 76 Avenue
Edmonton T6G 0K1

Mr. B. Bustin
Industrial Arts Department
Oliver Junior High School
10210 - 117 Street
Edmonton T5K 1X6

Messrs. E. Butt
W. Williams
Industrial Arts Department
Ottewell Junior High School
9435 - 73 Street
Edmonton T6B 2A9

Mr. E. F. Bishop
Industrial Arts Department
Spruce Avenue Junior High School
11424 - 102 Street
Edmonton T5G 2E7

Messrs. J. Kostyshyn
J. McCaslin
Industrial Arts Department
Vernon Barford Junior High School
32 Fairway Drive
Edmonton T6J 2C1

Messrs. R. Sagert
B. Williamson
Industrial Arts Department
Westlawn Junior High School
9520 - 165 Street
Edmonton T5P 3S4

Mr. H. Porter
Industrial Arts Department
Central School
Hughenden

Mr. R. C. Nutter
Industrial Arts Department
St. Mary's Junior High School
2 Avenue & 11 Street S.W.
Medicine Hat

Mr. C. Schwalbe
Industrial Arts Department
South Central School
Oyen T0J 2J0

Mr. A. Johnson
Industrial Arts Department
T. A. Norris Junior High School
Peace River T0H 2X0

Messrs. J. Gordon
R. Lugg
W. Sprado
Industrial Arts Department
Rimbey Junior-Senior High School
Rimbey T0C 2J0

Mr. D. McFetridge
Industrial Arts Department
Sir George Simpson Junior High School
50 Grosvenor Blvd
St Albert T8N 1L5

APPENDIX E

IN THIS APPENDIX CAN BE FOUND THE ADDRESSES OF THOSE INSTITUTES OR GOVERNMENTAL DEPARTMENTS CONTACTED BY THE RESEARCHER FOR INFORMATION PERTAINING TO THEIR RELEASES DIRECTED AT METRIC CONVERSION.

DOCUMENT	AVAILABLE FROM	DATE
Industrial Training for Metric Conversion in Australia	Metric Conversion Board 18-24 Chondas Street St. Leonards 2065 N.S.W.	1971
Metric Conversion Board First Annual Report for Year 1970-71 Parliamentary Paper No. 260	Commonwealth Government Printing Office Canberra	1972
Conversion of Canadian to International Metric Units CSA Standard Z234.1	Canadian Standards Association 178 Rexdale Blvd. Rexdale 603, Ontario	1970
Standards in Canada by Robert F. Leggett	Information Canada Ottawa, Ontario	1970
Units by Theodore Wildi Laval University	Vota Inc. P.O. Box 425 Sillery, Quebec 6	1972
Metric Change in India Edited by Lal C. Verman and Jainath Kaul	Indian Standards Institution Manak Bhavan 9 Bahadur Shah Zafar Marg New Delhi, 1	1970
Metric Sizes for Basic Materials	SABS Private Bag 191 Pretoria, S.A.	1970
Modular Coordination in Building	Civil Engineering Department South African Bureau of Standards Groenkloff, Pretoria	None

DOCUMENT	AVAILABLE FROM	DATE
A Guide to Metrication by M. J. B. Jones	Pergamon Press Ltd. Headington Hill Hall Oxford, OX3 OBW	1969
Going Metric - Looking Ahead	Metrication Board 22 Kingsway London, WC2B GLE	1972
Going Metric: Seminar Reports	Design Council 28 Haymarket London, SW1Y 4SU	1969
Going Metric With the British Paper and Board Industry	Plough Place Fetter Lane London, EC2A 1AL	1970
Industrial Metrication by J. Peach	Teach Yourself Books St. Paul's House Warwick Lane London, E.C. 4	1970
Learning Metric	Dunlop Limited London	1972
Making the Most of Metrication by Colonel J. S. Vickers	Gawer Press 140 Great Portland London, W1N 5TA	1970
Metric Change A Management Action Plan by R. Baden Hellard and J. V. Connolly	Kogan Page Limited 16 Gray's Inn Road London, W.C. 1	1971

DOCUMENT	AVAILABLE FROM	DATE
Metric Packages: The Position Today	British Standards Institution 2 Park Street London, W1A 2BS	1970
Metrication Edited by F. W. Kellaway	Penguin Books Ltd. Harmondsworth Middlesex	1968
The Change to the Metric in the United Kingdom	British Metrication Board 22 Kingsway London, WC2B GLE	1971
The World of Measurements	Webster Division McGraw-Hill Book Co. Ltd. Maidenhead, Berkshire	1961
Think Metric	Dunlop Limited London	None
We're Going Metric (Educational Booklet) by John D'Arcy and Graham A. Knox	Heinemann Educational 48 Charles Street London, W1X 8AH	1971
Working in Metric Units (A programmed learning text) by M. J. B. Jones	Elsevier Publishing Co. Ltd. Barking, Essex. or American Elsevier Publishing Co. Inc. 52 Vanderbilt Avenue New York, N.Y. 10017	1970
Report to Congress A Metric America: A Decision Whose Time Has Come (NBS SP345-1)	Superintendent of Documents Government Printing Office Washington, D.C. 20402	1971

DOCUMENT	AVAILABLE FROM	DATE
A History of the Metric System Controversy in the U.S.A. (NBS SP345-10)	Superintendent of Documents Government Printing Office Washington, D.C. 20402	1971
Metric Conversion (Hearing before the Committee on Commerce, United States Senate; "Second Session on S.2483")	Superintendent of Documents Government Printing Office Washington, D.C. 20402	1972